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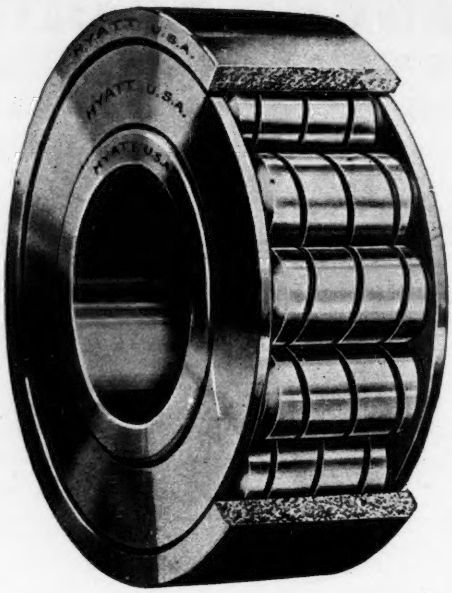

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AGRICULTURAL ENGINEERING

The Journal of Engineering as Applied to Agriculture

Vol. 8 MARCH, 1927 No. 3

Recent Developments in Agricultural Wheels

By E. R. Wiggins

Mem. A.S.A.E. Agricultural Engineer, French & Hecht

THE effect of higher speeds and heavier loads is seen in the design and construction of wheels for agricultural and allied purposes. In a word, the wheels of today are being made very much stronger than heretofore, but with no appreciable addition in weights. If there are any changes in weight, it is toward lighter wheels. This is being brought about by a selection of stronger and lighter material together with advanced knowledge in the art of wheel building.

As much a contributing factor as any in the design of the modern wheel is the very general use of the tractor. With power available plowing speeds of 3½ miles per hour are not uncommon. Compare this with the 1½ and 2 miles per hour plowing speed of the earlier tractors and with animal plowing speed.

Implement wheels nowadays have another speed load to carry never before met. Delivery of implements from the implement store to the farm is made in many instances by trailing them back of motor trucks. We often see cultivators hitched behind automobiles clattering over concrete roads at from 15 to 20 miles per hour or faster. Threshers and similar machines are transported by trailing them back of motor trucks, for distances sometimes as high as 30 miles or more, not to mention the distances these machines are hauled over hard roads during the working season.

Deeper plowing, wider seed drills, wider cuts for binders and combines, two-row cultivators in place of one-row, heavier tonnage on wagons and trailers, all have increased the weight loads on wheels.

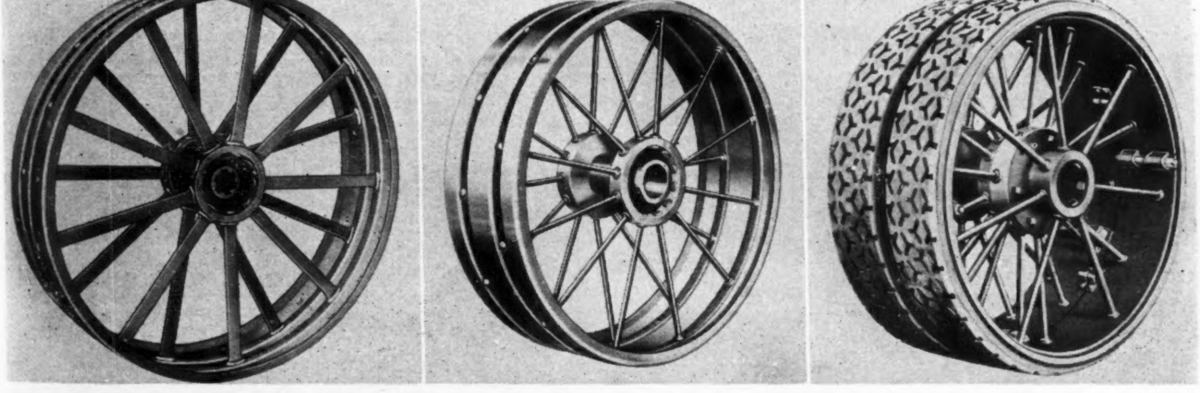
The distribution and kind of loading have changed, also due to changes in methods of drive and machine design generally. Take tractors as an illustration. A method of final drive that formerly prevailed was the bull gear and pinion. This required that power from the bull gears to the wheels be transmitted through tangential braces that extended from the gears to the inside rims of the wheels. Thus the spokes were required to carry the weight load mainly. Today many tractors have live-axle drive and here the torque of the engine is delivered through the hubs and spokes to the rims. Entirely different severe stresses and strains have to be met.

The advent of the power take-off has meant a change in wheel design for harvesters, corn binders, corn pickers and similar machines. Main wheels on these machines are purely transporting members. Whereas previously not only did these wheels carry the machines, but the driving power came from the wheels as they rolled over the ground similar, yet opposite, to tractor drivewheels.

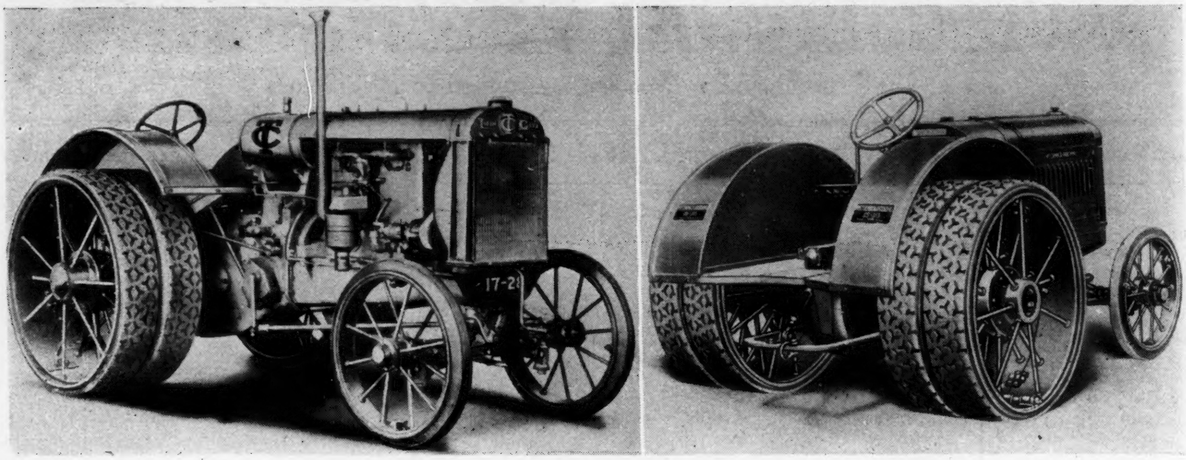
Typical Wheel Designs. With what has been said as a background, let us consider certain typical wheels. Agricultural tractors in the main are using flat spokes, with light flanged and grooved rims. Added strength without excessive weight, always an important consideration in tractor service, is gained by this light weight tire having the edges flanged inward, and two grooves near the middle. The grooves give additional stiffness to the tire and at the same time provide protection for the spoke heads. This is an advantage, especially whenever the tractor is used on hard roads. Having the spoke heads below the face of the tire allows the cleats and lugs to be spaced in any desired position. Flanging the tire enables the makers to construct the wheel much lighter in weight than would obtain with an ordinary flat-bar rim.

A typical wheel illustrating this design has its hub splined to fit the splined axle shaft. Because the flat or wide sides of the spokes are parallel to the edges of the tire, strength is provided to take care of torque loads. Placing the spokes in a trussed position takes care of all side or lateral thrust loads that come so commonly on a tractor.

There are many methods of attaching the spokes to the hubs and rims. An accepted method is that in which the steel spokes are forged while hot into the hub and have heads formed on the inside of the hub and shoulders on the outside. This produces a spoke fastening similar to that of



(Left) Flat spoke tractor drivewheel with a flanged and grooved tire. (Middle) A typical "combine" wheel with round spokes and flanged and grooved tire. (Right) 50-by-10-inch dual tire on a tractor, showing the main wheel and the extension wheel in the two sets of drivewheels, giving a ground contact of 40 inches. The two wheels are held together by bolts through clips at the rims and bolts through the hubs. The hubs are so made that the outer end of the main wheel hub rests in a recess in the extension wheel hub. Note the expansion wedges in the extension wheel which are the means used for expanding the wheels into the tire

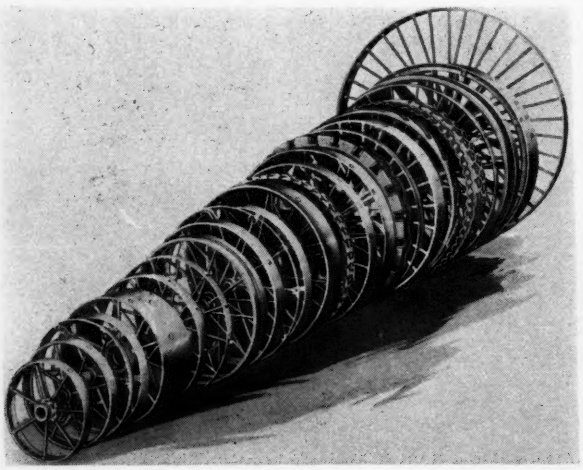


(Left) 50-by-10-inch dual tires on expansion wheels on a Twin City 17-28 Tractor. (Right) 50-by-10-inch dual tires on expansion wheels on a McCormick-Deering 15-30 tractor

a boiler rivet. The shape of the spokes is such that strength is placed at such points as most needed. At the hub end of the spokes the shoulder and tenon are so designed as to add strength to the point on the spoke a short distance from the hub.

The use of flanged and grooved rims appears to be a modern development that extends beyond that of tractor usage. This design is being used in implements and machinery such as combines, harvesters, corn binders, threshers, shredders, and many machines used for industrial purposes. A typical example of a late wheel using this type of a rim is that used with combined harvester-threshers. The example in mind uses the flanged and grooved type similar to that dscribed for the tractors having the same method of attaching the spokes to the hub and rim but using round spokes in place of flat spokes. The "combine" derives its power from a power plant of its own, or from a power take-off from tractor, so there is no torque load to be provided for as was previously mentioned in connection with the tractor wheel. The spoke heads are placed below the face of the rim and thus protected against excessive wear. The jolting of the machine is also eliminated when being transported over hard roads. Flanged and grooved tire shapes produce maximum strength with comparatively light weight.

The steel tires are welded, as it has been found in practice that splice plates and rivets for connecting the tire ends together, are not entirely satisfactory. This method of construction, having the round spokes in the wheels, produces such a wheel that the spokes are all uniformly drawn into the tire, and each of the spokes carries its proper proportion of the load. This is a very necessary and important point in modern wheel construction.

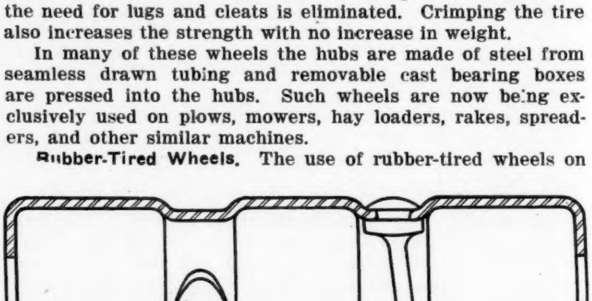


This illustration shows a few of the vast variety of wheels that are now used in agricultural and industrial fields. Here is a range of wheels running in diameter from 14 inches for a tongue truck wheel up to and including a 78-inch diameter cane cart wheel. In this typical assortment of modern wheels may be seen corn binder wheels, plow wheels, thresher wheels, road grader wheels, rubber-tired wheel, tractor wheels, hay rake wheels and other kinds of wheels

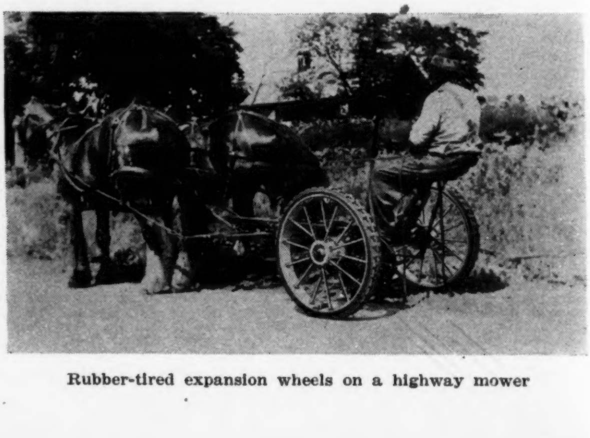
A very interesting development in implement wheel design is that with the crimped rim or tire. An example of such a wheel is that used on a power-lift wheel plow for tractor service. Because traction is desired to operate the plow lift the tire is made with a crimped section. Thus the need for lugs and cleats is eliminated. Crimping the tire also increases the strength with no increase in weight.

In many of these wheels the hubs are made of steel from seamless drawn tubing and removable cast bearing boxes are pressed into the hubs. Such wheels are now being exclusively used on plows, mowers, hay loaders, rakes, spreaders, and other similar machines.

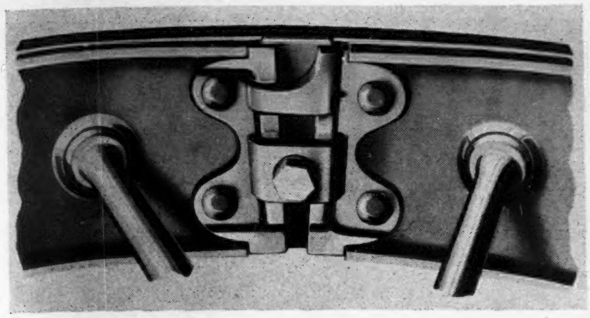
Rubber-Tired Wheels. The use of rubber-tired wheels on



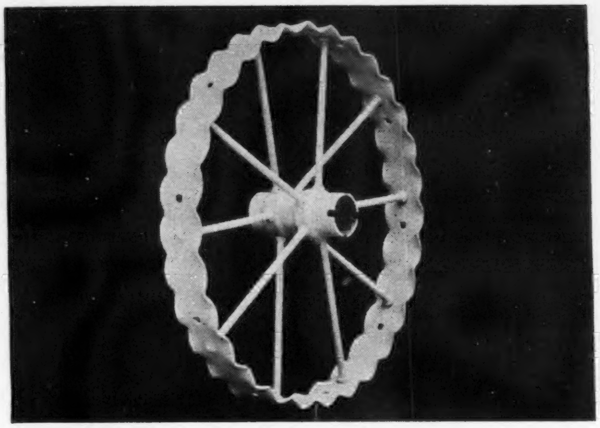
Cross-sectional view showing method of attaching flat spokes to the tire. Note that the spoke heads are located in the grooves making possible a reduction in the rear of the heads and also providing for smoother operation over hard roads



Rubber-tired expansion wheels on a highway mower



A detail view of the expansion wedge device. This expansion wedge device is used on wheels for highway mowers, threshers, trailers, and other similar equipment. This view shows the expansion wedge as driven in between the ends of the tire and clearly brings out the locking device to hold the wedge in place, should there be any tendency for wedge to move outward



A tractor plow wheel having a crimped tire and steel hub made from seamless drawn tubing into which is placed a removable cast bearing box

tractors, highway mowers, threshers, trailers, etc., is growing due to the fact that steel wheels with cleats or plain steel wheels have a tendency to damage the improved roads. Also the speed at which implements are transported over hard roads has greatly increased. Thus rubber tires are essential especially for the heavier machines and implements in order to absorb the shocks and add life to the implements.

In order to show typical designs of such wheels let us first consider typical rubber-tired wheels for tractors. While such wheels are not designed primarily for agricultural purposes, still we are finding much interest in these wheels on the part of the farmer. The very latest development in such wheels are those fifty inches in diameter and 10 inches wide which is the largest solid rubber tire ever brought out. In this particular wheel the use of what is called a low profile tire is made. This lessens the distance from the inside of the rim to the outside of the tire, being much less than is true with the standard type of truck tire so well known to everybody. Lowering the profile reduces the first cost of the tire, makes possible greater ground contact, and reduces the weight, not to mention other advantages.

In general these solid rubber tires are the same type used for modern truck service, in that the rubber is vulcanized on the channel steel base. A nonskid or tractor tread on the outer circumference aids in good traction and at the same time is shaped to provide wearing quality with consequent long life. In tractors of medium size we find these particular wheels being used singly or dually. In the latter there are 40 inches of ground contact. Typical of modern design extension wheels are used rather than overhanging extension rims and to secure a very strong attachment between the extension wheels and the main wheels these are bolted together at the rims and at the hubs. This arrangement secures a solid rigid unit connection between the two wheels. The outer end of the main wheel is machined to fit into the machined recess in the extension wheel hub.

Another point in design of this typical wheel is the fact that it is of the expansion type, whereby no power press is required to change tires. Expanding wedges in the steel rims make it possible with the use of a heavy hammer and an ordinary wrench to change tires. In modern wheel design the matter of weight has been given much consideration, and where unusual conditions are to be met additional wheel weights can be applied to these wheels.

In general, however, it has been found that with rubber-tired wheels on tractors, only weight enough to secure the necessary traction is needed. Beyond this point all weight in the wheels is excessive, and therefore uneconomical operation results.

The principle of the flanged rim is now being applied to rubber-tired wheels for highway mowers, threshers, trailers, and other equipment. A late design shows this type of rim under the rubber tire in which but one expansion wedge is necessary to hold the tire in place on the wheel.

Cotton Sledding Becoming Important Harvesting Method

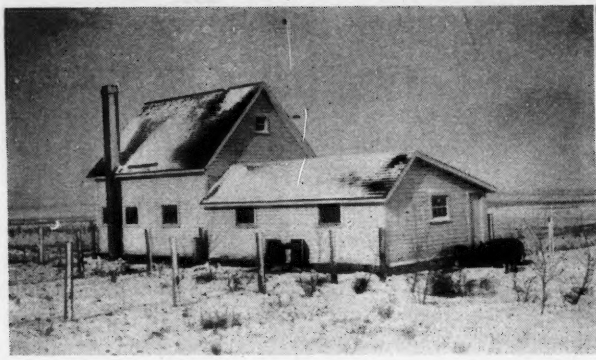
LOW cotton prices this season have stimulated in Texas and Oklahoma a great increase in a low-cost method of harvesting cotton which was first practiced about 10 years ago. This is the use of sleds or strippers for pulling or snapping cotton from the stalks. Two main types of sleds are in general use. One type is adapted for harvesting small cotton (the kind usually grown in the Staked Plains area) and the other for harvesting cotton where the plant has a more vigorous growth. The latter type is used chiefly in the bottom lands of the plains area, and in some areas farther east.

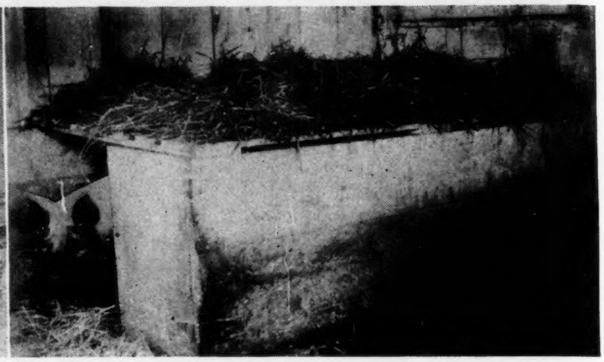
Although this method of harvesting cotton often leaves 15 per cent or more of the crop in the field, it is immensely cheaper than picking. It is considerably cheaper than snapping cotton by hand. Indeed, it is generally believed by the cotton farmers that sledding is only an emergency method of harvesting. Nevertheless, some producers contend that sledding has come to stay, and that great improvement will be made in this harvesting method. Ginners say that cotton sledded under ideal conditions is of about the same quality as the usual run of snapped or pulled cotton. But where fields are grassy or where badly constructed sleds are used, the method may give poor results.

Other conditions besides low cotton prices may favor the spread of cotton sledding. Among them are scarcity of labor and early frosts. In the newer cotton areas of Texas and Oklahoma, where machine methods enable cotton to be produced on a more extensive scale than in other parts of the Cotton Belt, farm families can cultivate much more cotton than it is possible for them to harvest without additional labor. Thus the problem of harvest labor in the cotton fields arises. Furthermore, the picking operation becomes too difficult after killing frosts, because the burrs then break off the stalk at a touch. Sledding partially solves the double problem of economizing harvest labor and saving cotton that has been caught by early frosts.

Although sledding cotton has been described as simply a mechanical means for snapping or pulling cotton, the operation is not really adequately described by the terms snapping and pulling. The sleds have toothed arrangements, not unlike mower guards. They strip all bolls from the stalks regardless of their state of maturity. Naturally considerable foreign material is harvested at the same time. This at first caused some ginners to oppose the use of the sled, but recently they have shown less opposition.

Sledding was used on an enormous scale in the western part of the cotton area the past season. Data are being compiled by the U. S. Department of Agriculture as to the amount of cotton harvested in this way. Estimates of the amount of snapped and sledded cotton in Texas and Oklahoma run from three to four million bales, which is a good proportion of the western crop.





(Left) Piggery at Swift Current, Saskatchewan, Canada, designed by the experiment farms branch of the Dominion Department of Agriculture. (Right) Sleeping berth in piggery

Economical Piggery Construction

By R. A. V. Nicholson*

Mem. A.S.A.E. Architect, Dominion Experimental Farms Branch, Dominion Department of Agriculture (Canada)

THE Dominion Experimental Farms Branch of the Dominion Department of Agriculture has, during the past few years, attempted to design a piggery which would embody the principles of convenience and sanitation and yet be within the reach, in cost, of the average farmer. The result is shown in the accompanying illustrations.

The building consists of a two story portion containing a feed room and farrowing pen with a one story wing containing two feeding pens. The main portion is double sheathed and the farrowing pen built with a low partition open to the feed room so that heat may be obtained at all times. The feeding pens are single boarded with a straw loft above and berths, also straw covered, provide warm sleeping quarters; the exterior walls are double sheathed around the berths only. Small doors provide access to the exercising yards. Concrete floors are used throughout, wood floors being laid over these in the sleeping berths.

Sliding windows are provided between all pens so that feeding pens may be warmed and used as farrowing pens, if necessary. The number of feeding pens may be increased, but the number shown is usually sufficient for the small farmer.

Ceilings are 7 feet in height throughout, as any greater height is difficult to keep warm. The feeding troughs are movable and the pen front consists of pivoted panels; the pen faces of these panels are lined with galvanized iron so that, when swung open, the feed may be poured down into the troughs. The panels may then be swung to and bolted in place.

The building is relatively low in cost and provides warm sleeping quarters, comfortable feeding space and ready access to exercising yards.

Two of these piggeries are already in use on the Canadian Experimental Farms system—at Swift Current, Sask., and Invermere, B. C.,—and have proved eminently practical and suitable for raising winter pigs during the past two years.

*Member Royal Architectural Institute of Canada.

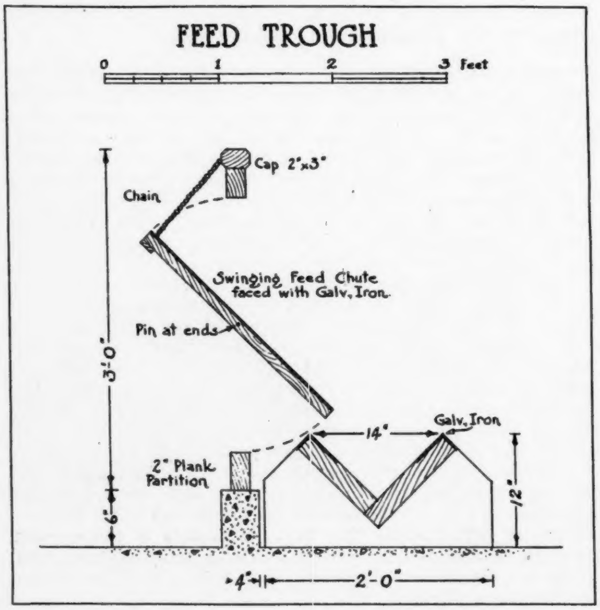
Experiment Station Report

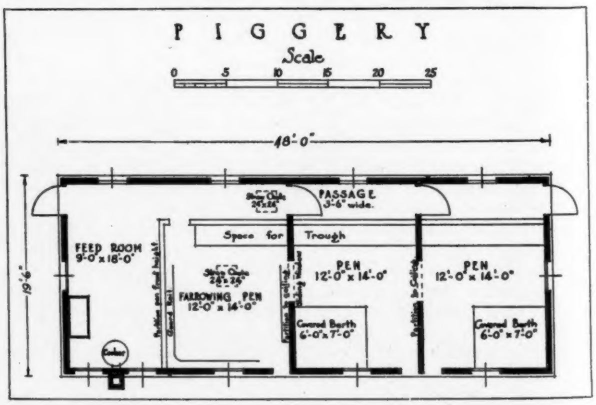
THE report of the chief of the U.S.D.A. Office of Experiment Stations, Dr. E. W. Allen, to the Secretary of Agriculture for the fiscal year ended June 30, 1926, is of particular interest to agricultural engineers.

The report points out that something over six hundred Purnell projects were reviewed and approved for the year, of which only fourteen dealt with agricultural engineering, a fact of peculiar significance to agricultural engineers.

The report also outlines the policy with reference to the use of Purnell funds for experiment station work.

Copies of the report may be secured by writing the chief of the Office of Experiment Stations, Washington, D. C.





(Left) Details of feed trough and (Right) ground plan of piggery in use on the Canadian experimental farms

Results of Research in Feed Grinding*

By Geo. W. Kable

Mem. A.S.A.E. Agricultural Engineer, Oregon Agricultural College

THE problem of grinding feed on the farm is now engaging the attention of many of agricultural experiment stations and especially those interested in the possibilities of using electricity in income-producing operations on the farm. Investigations have been in progress at the University of Wisconsin for several years and various phases of the feed grinding problem have been experimented with at Iowa State College. Committees on the relation of electricity to agriculture in Kansas, South Dakota, Illinois, Virginia, Minnesota, and Alabama, all have the problem of feed grinding on their programs. Most of these committees are working toward the same end. The first information sought is what type, make, and size of grinder is best suited for farm use. The next concerns the possibility of automatic operation with small power units. Each state has its own methods of attacking the problem and few of the results obtained are comparable.

Grinding experiments were started by the Oregon Agricultural Experiment Station in the fall of 1925. Tests are still under way. Most of the tests have been made by Messrs. Hurd and Russel, senior students in electrical engineering. The first phase of our problem has been to study mills of different types and sizes to learn which are most satisfactory and economical for farm use.

Motors of 3, 5, 10 and 15 horsepower and of known efficiencies were used to drive the mills. Power measurements were made with watthour test meters and the characteristics of operation studied with a graphic wattmeter. Mills were belt connected to motors. No allowance was made for belt losses. Each individual test was of five minutes to several hours duration and the average amount of grain ground was about two hundred pounds.

The quality of grinding was finally determined by screening after considering various methods. The screening equipment consisted of a small-sized Ferrell grain, seed and bean cleaner with the fan disconnected. The machine was equipped with two wire screens 8¾ by 10½ inches in size and having ten (0.083 inch opening) and twenty (0.04 inch opening) meshes to the inch. The ground grains were fed onto the upper end of the coarser screen by hand, and the screening was completed when all of the grain had been shaken through or over the screens. This method of screening was not violent enough or of sufficient duration to beat apart the cracked particles of grain or to result in as large percentages of fine material as if the samples had been shaken for longer periods in closed sieves. The results, however, are comparable.

Some of the variables encountered in making tests and comparisons of feed mills are listed below: Types of burrs; burr setting; burr spring compression; burr sharpness; rate of feeding; speed of mill; grain variety; grain quality; moisture content; roll setting in roller mills; roll spring compression; and screen openings in hammer mills.

*Paper presented at the 20th annual meeting of the American Society of Agricultural Engineers at Lake Tahoe, Calif., June, 1926.

Not all of the possible combinations of these variables have been attempted in tests which have been made. No attempt has been made to grind to a given standard of fineness as a basis of comparison. Our method has rather been to make combinations of variables which are likely to occur in practice and then determine the quality of product resulting and the power consumed.

Varieties of Grain Ground

KIND	Weight pounds per bu.	Per-cent moisture
Barley No. 1—white-bearded variety containing weed seeds and some smut	46.0	11.0 (approx.)
Barley No. 2—Hannchen, clean and very hard	55.8	12.1
Oats—white feed oats, mixed	36.5	10.9
Wheat—mixed, soft wheat	59.5	10.7
Corn—shelled	52.0	10.9

Mills Used in Grinding Tests

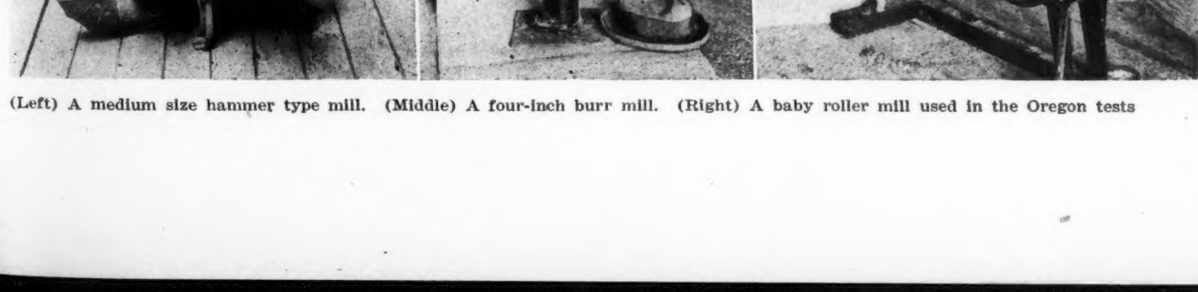
Make	Type	Size	Power rating	Cost*
Stover	Burr	No. 40—8-in. burrs	10-15	$ 74.50
I. H. C.	Burr	Type C—6-in. burrs	3-8	45.00
F. M.	Burr	No. 04—4-in. burrs	About 1	10.00
W. W.	Hammer	Model 55 T—18-in.	15-18	480.00
J. B.	Hammer	2 A	15-25	
Carley	Roller	Baby—rolls 2½ in. face by 14 in. diam.	2-3	67.00 plus freight

*Approximate prices f.o.b. Portland

Fineness of Grinding. For fine grinding the hammer mill ranks first, burr mill second, and roller mill last. An attempt was made in the Oregon tests to grind to the degree of fineness arbitrarily set by Prof. Morrison, of Wisconsin, as a standard for oats. This standard is 20 per cent or less on a No. 10 screen, and 55 per cent or less on No. 10 and No. 20 screens combined. While most of our burr mill tests have been made with close burr settings, we have been unable to attain this standard.

Power Loss in Heat. The temperature increase in ground grains varied from 4 to 58 degrees. The change in temperature varied almost directly with the power used per hundred pounds ground. Practically the same temperature changes took place when using the roller mill as when grinding with burrs and the causes of the increases were either the close setting of burrs or rolls, or a reduction in the rate of feeding. It was noted also in some of the runs that the temperature of the air in the discharge throat was several degrees higher than that of the ground grain, indicating that the grain passed through so quickly that its temperature did not always indicate the actual heat loss. Temperature increases in grinding with hammer mills could not be ascertained because of the cooling effect of the air blast.

Effect of Different Burrs. Tests Nos. 1, 2, 7, 47, and 9 give comparisons between the grinding of coarse, fine, and



(Left) A medium size hammer type mill. (Middle) A four-inch burr mill. (Right) A baby roller mill used in the Oregon tests

crowfoot burrs. In order to approach the degree of fineness recommended by Morrison, it was necessary to use the fine burrs for all grains. The fine burrs gave greater capacity in the stover mill for the same degree of fineness than the crowfoot burrs and required considerably less power.

Burr Clearance. The effect of burr clearance as reported by McColly and Ilieff[1] does not show any consistent relationship to capacity, power per unit ground, or fineness. In general, with greater burr clearance the power per unit ground is less with a coarser corresponding product. In our tests where burrs were run very close to obtain maximum fineness it is noticeable that the power per unit ground increased rapidly when the clearances were very slight.

Burr Sharpness. Meacham and Krueger[2] gives the following data on effect of burr sharpness: (1) Badly worn burrs produced 100 pounds coarsely ground oats in 5.5 hours using 4.75 kilowatt-hours; (2) new burrs produced 100 pounds medium ground oats in 0.62 hours using 0.2 kilowatt-hours.

Throat Opening. Tests Nos. 6, 10, 31, and 37 on barley and tests Nos. 49 and 50 on oats give comparisons of the effect of different throat openings. In general the throat opening, which largely governs the rate of feeding, has a greater influence on the finess of grinding than any other factor. Added spring compression against burrs and rolls which ordinarily is expected to compensate for the increased rate of feeding was not found to be as effective as might be desired.

Speed of Burrs. Increasing the speed of the mill results in proportional increases in capacity and a reduction in the power requirements per hundred pounds ground. Mills were not speeded sufficiently high to determine to what extent this relationship will hold but from the few observations made indications are that a point would be reached beyond which increases in speed would be accompanied by greater power requirements per unit ground.

Power Requirements for Different Grains. Grains containing approximately the same percentage of moisture rank in the following order in power requirements per unit ground: Oats, barley, wheat, and corn. This order obtains with all of the mills tested regardless of type.

Conclusions Regarding Types of Mills. Conclusions which can be drawn regarding different types of mills from test data now available are not final. The number of variables encountered which influence the results is so great that it is almost impossible to isolate the influence of any one variable without making an elaborate series of tests. In this connection it would be very desirable if standards for testing could be agreed upon in order that tests which are being made by various states be comparable.

Burr Mills. Burr mills have the advantage of low first cost combined with the ability to produce a reasonably fine feed. For very fine grinding they are only moderately effective. They possess the disadvantage of requiring closer attention than roller or hammer type mills and will clog easier and need more frequent replacement of grinding parts.

Roller Mills. Roller mills are passing out of use for farm grinding. The reason is largely the demand for a finer product than can be produced between rolls. The cost of roller mills is higher than burr mills but lower than hammer mills. The mills are durable and require little attention in operation. The product from the rolls in grinding barley, wheat, and corn is not dissimilar to that from the burr mill except that the percentage of fine material obtainable is lower. Based upon the few tests made, the power required for rolling is somewhat greater than that used for the coarser grinding with burr mills. The continued use of roller mills will depend largely upon whether the coarser grinding will meet farm requirements.

Hammer Mills. The general impression has been that hammer mills consume an excessive amount of power. While there is considerable range in the power requirements of different mills, the power used compares very favorably with that of burr mills when grinding to the same degree of fineness. The hammer mill companies have been very reticent in having tests made on their mills and especially on mills of the smaller sizes. Results of tests which are available have shown that even these smaller mills are relatively low in power requirements for fine grinding. The chief advantages of hammer mills are their ability to handle most any product from straw to stone and to grind very fine without clogging or being seriously injured by foreign matter in the grain. The main disadvantage is their high cost.

Automatic Operation of Mills. The equipment of a feed room so that grains may be ground by electric power without the attention of an operator does not seem impossible. Mills of the hammer type offer greatest promise in this respect.

Certain precautions will be necessary for the automatic operation of any mill. In addition to a starting mechanism there should be automatic control devices to guard against injury from overloading and from operating the mill without grain. With all mills a system of screening out straw and foreign material from the grain is desirable and with burr mills in particular would be quite essential. The addition of a magnetic device for removing small particles of iron might also be an advantage.

Messrs. McColly and Ilieff have reported tests of two automatic burr grinding units in the thesis previously referred to. One of the mills had 6-inch burrs and was geared down so it could be operated with a one-horsepower electric motor. The other had 4½-inch burrs and was operated at rated speed. Both mills worked to the satisfaction of the operators. Neither mill was outstandingly better than the other in the product produced or in power requirements per unit ground. Conclusions regarding the economics of operation were as follows:

Cost of Installation and Operation

	McCormick-Deering		Stover	
Installation Costs*	Automatic	Nonautomatic	Automatic	Nonautomatic
	$152.30	$113.50	$107.10	$81.00
Operating Costs				
Interest, Depreciation and Repairs	$0.081	$0.061	$0.056	$0.043
Power	0.108	0.108	0.123	0.123
Labor	0.015	0.300	0.015	0.225
Total	$0.204	$0.469	$0.194	$0.391
Cost per 100 pounds	$0.116	$0.268	$0.111	$0.224

*Includes grinder, motor, drive, automatic devices, wiring and frame.

I wish to mention one other point bearing upon farm feed grinding. It is the desirable finenesses from the standpoint of feeding value. Practically no data is available upon this subject.

By analyzing samples of various commercial dairy feeds and egg mashes and talking to feed salesmen we find that the farmer usually prefers the finer ground feeds.

So far as we have been able to learn there is no experimental data to substantiate the notion that the very finely ground feeds give much better results. Before the agricultural engineer will be in a position to make definite recommendations regarding mills he should have data from the livestock man telling him which degree of fineness of grinding or crushing is responsible for most economic returns in feeding.

[1]Thesis: The Design, Construction and Tests of Small Automatic Feed Grinding Units, Iowa State College, 1926.
[2]Summary Report, Wisconsin Committee on the Relation of Electricity to Agriculture, Feb. 1924 to Jan. 1926.

Paint Remover from Factory Waste

AN EFFECTIVE paint and varnish remover can now be made by a process discovered and patented by Dr. Max Phillips and M. J. Goss, chemists of the color laboratory, U.S.D.A. Bureau of Chemistry, who have just completed an investigation on the utilization of para cymne, which comes from an oil obtained as a by-product in making paper pulp from wood. The oil from which the new paint and varnish remover is made was until recently almost wholly an economic waste. It has been variously estimated that from 750,000 to 2,000,000 gallons of this material are annually produced in the sulphite pulp mills of the United States. The paint and varnish remover is prepared by mixing para cymne with grain alcohol, wood alcohol, and acetone, in equal parts by volume.

The most effective method for removing paint and varnish is to apply the new remover to the surface to be treated, and after three to five minutes the softened paint or varnish may be very easily removed by means of a scraper.

Results of "Combining" and Grain Drying Tests in Wisconsin*

By F. W. Duffee

Mem. A.S.A.E. Associate Professor of Agricultural Engineering, University of Wisconsin

THE first work we did at the University of Wisconsin looking toward the use of the "combine" was in the winter of 1924-25. A student investigated the possibilities of drying grain in the bin by blowing air in at the bottom of the granary and up through the grain. It was found easily possible to force air through grain at depths up to 6 to 7 feet. Greater depths have not been tried as ordinarily grain is not stored on the farm to much greater depths.

Our studies so far have not dealt with the economies of the combine, but merely with the mechanics of the combining process.

In the summer of 1925, four hundred and fifteen bushels of barley were cut at the usual stage of ripeness and immediately threshed. This grain was stored in a bin equipped with a false bottom, so that forced ventilation could be used. The bin was 9 by 16 feet and the grain was 3½ feet deep. The upper or slatted floor was made of 8-inch boards spaced about ¾ inch apart. The grain appeared to be in first-class condition until it was removed, when it was discovered that there was a slightly musty condition in the bottom. It was thought that this condition was due to using such wide boards, namely 8 inches, there being an A-shaped mound of grain over each board that was not ventilated.

This trial tended to convince us that probably in most seasons artificial ventilation would be required in our climate, although this barley was cut at about the usual stage of ripeness.

On August 2, 3, and 4, 1926, a combine demonstration was made on one of the university farms. Oats and barley were cut during this demonstration. The most abnormal season for years made it impossible to gather considerable data which we had wished to secure, and also rendered some of our observations of less value than had the season been normal.

A few words regarding the weather seems pertinent at this time. It rained or drizzled almost continually for about eight days prior to the demonstration. In fact, it rained Sunday night as late as about midnight, and we started cutting oats between 10 and 11 o'clock the next morning. The soil was in good condition for the work, but the total rainfall for the year at Madison even after these rains was only about 70 per cent of normal.

Only a small patch of oats was cut in the forenoon, and some tangling and winding on the platform and elevator took place as the straw was still a little tough; this was largely overcome in the afternoon. The oats would have been cut with a binder about a week sooner, and except for the rain we would have cut them with the combine some three or four days before we did. The oats were standing up in fine shape except for a patch in a swale; this, however, was lodged before the rest of the field was ripe enough to cut with a binder.

It is generally considered that grain must be at least down to 14 per cent moisture to keep well. The oats cut with the combine varied from 12 to 13 per cent and the composite sample tested 12½ per cent moisture. It was rather light quality of oats, but they threshed and cleaned well. The loss from the machine even on the side hills was very slight except for one round just after noon. This was probably partly due to too much wind as the straw had dried considerably over the noon hour.

Cutting Barley. If the combine is to make any headway in this section of the country, it would seem that it must handle all grains, and as barley is a fairly important grain crop in Wisconsin, we have spent most of our time working with it. Barley is a much better crop to grow that oats. It yields more bushels per acre, and the feeding value per bushel is higher. The bearded barley yields much better and the feeding value is higher than beardless barley. But the handling of bearded barley is very obnoxious. The combine overcomes this difficulty; therefore, it would seem to have a bearing on agriculture in Wisconsin other than just the financial or labor-saving element.

Three phases of combine experience will be discussed as follows:

1. The performance of the machine
2. The handling of the grain in the granary
3. Saving the straw
4. Some observations regarding the improving of combines, with special reference to Wisconsin conditions.

The Performance of the Machine. The machine did very good work considering the condition of the straw. It was a fairly heavy crop, averaging about 35 bushels per acre. Most of the grain had crinkled; that is, the straw had bent over a few inches below the head. The straw was very ripe and light, and this, with the crinkled condition, tended to cause lodging on the platform and clogging in the elevator, carrying the unthreshed grain up to the feeder housing of the combine. This crinkled condition is always likely to be encountered to some extent with barley that is very ripe.

The grain was cleaned in excellent condition, in fact, better than was possible with our threshing machine which is a late model and a good machine. The grain was completely threshed from the heads and the beards rubbed off well, also very little grain was carried over by the separator which was of the prairie type, even on fairly steep side hills, or going up grades of 13 per cent.

The grain was badly lodged in two small areas, but this had taken place before the grain was anywhere near ripe enough to cut with a binder. The agronomists tell us that lodging usually takes place before ripening rather than after; as further evidence of this I saw grain standing up in fine shape in northern Wisconsin as late as September 25 this fall, having stood up through the heaviest rainy season known for years.

Five rounds were cut around the outside of the field with a grain binder; this strip was through one of the badly lodged spots. The first round with the combine could be easily seen for weeks after cutting as it picked up the down grain better than the binder. The binder, however, was not equipped with special lifting guards.

Comparative Loss of Grain by the Two Methods. Plans had been made to check up carefully on the grain losses of the combine as compared to the binder and threshing machine. However, the very unusual weather conditions made this impractical. About half of the 32-acre field was cut with the combine and half with the binder. That cut with the binder was cut last. The straw was so badly crinkled that it was almost impossible to tell the butts from the heads of the bundles, and a great many heads slipped from the bundles for this reason.

The grain in the center of the field which was cut with the binder was never shocked, but was threshed direct from the windrow after lying there about one day. It was possible to locate almost every windrow after the grain was hauled off, by the large amount of loose heads left on the ground, proving rather conclusively that under these very extraordinary conditions the combine lost much less grain than the binder.

Power Required for the Combine. The combine used was a Case 9-foot machine, operated by a Case 18-32 tractor, running in low gear and using a power take-off drive. On the

*Paper presented at a meeting of the Farm Power and Machinery Division of the American Society of Agricultural Engineers, at Chicago, December, 1926.

steeper grades encountered, amounting to 13 per cent in some cases, the tractor had all it could do to handle the job, it being necessary where the grain was heavy to pull out a little and cut a narrower swath to avoid too great a speed drop. On the level the tractor seemed to handle the load very easily.

Spade lugs were used and it was the opinion of the agronomists that no material damage was done to the seeding of grass.

Handling the Grain in the Bin. The moisture content of the barley at cutting varied from 14.5 to 15 per cent, averaging about 14.8 per cent for the 547 bushels cut with the combine.

This grain was placed in a special bin (See Fig. 1) with a double bottom. The upper one was a perforated bottom so that air could be blown in between the two floors and would find its way up through the grain. The upper floor consisted of 1-by-2-inch strips laid flat on two-by-fours spaced one foot apart, and raised up on 2-inch blocks, thus allowing free distribution of air between the two floors.

A No. 3 Bayley Plexiform fan was used operating at about 1200 r.p.m. Three observation stations in the space between the two floors indicated that quite a uniform pressure of from 1.35 to 1.5 inches of water was maintained throughout. Data on the fan indicates that the pressure at the fan outlet would be at least 2 inches of water under these conditions. This would indicate that uniform conditions of ventilation would be secured, which was verified by using smoke as an indicator. In this way it was also determined that less than 10 seconds were required for air to pass from the inlet of the fan through to the surface of the grain. No artificial heat was used.

While no accurate measurements were made, indications were that the fan was probably delivering 4500 to 5000 cubic feet per minute, which is about its maximum. The same fan could easily take care of several times this amount of grain (about 700 bushels total, as some grain cut with the binder was thrown on top of the "combined" grain) by blowing the different bins at different times in the day. The above data which is not particularly accurate indicates that approximately 33 cubic feet of air per minute, per square foot of floor area will be ample.

Air pressure between the two floors equal to or in excess of 1.35 inches of water appears to be sufficient to provide adequate ventilation; under these conditions air will pass through 5 or 6 feet of barley in less than 10 seconds.

Cost of Blowing 1000 Bushels

Fan (Initial cost $80.00)—interest and depreciation	$6.00
Increased cost of granary ($25.00)—interest and depreciation	2.50
Annual cost of extra equipment	$8.50
Blowing 70 horsepower-hours at 10c	7.00
Labor attending to blowing—2 hrs. at 30c	.60
Total cost of drying 1000 bushels	$16.10
Cost per bushel	1.61 cents

This cost is based on drying grain that is quite ripe. It is thought that a very liberal amount of blowing is being allowed, and that therefore the cost figures are high. Also the fan could take care of several times this amount of grain by blowing different bins at different times of the day.

The grain was threshed on Tuesday and Wednesday and the first blowing was done on Thursday at 4.00 P. M. No blowing was done on Friday, but it was blown approximately twice a day for intervals of 30 minutes on Saturday, Sunday and Monday. It was blown for longer periods (Fig. 3) for four days longer in an effort to lower the moisture content.

The temperature of the grain was slightly above 90 degrees Fahrenheit when put in the bin, being approximately the same as the outdoor temperature. Blowing was done mostly in the morning and evening so as to reduce the temperature rapidly with the idea of retarding molds as much as possible. Fig. 3 shows the temperature of the grain until it had dropped to approximately outside mean temperature.

The grain was cut on Tuesday and Wednesday and on the following Monday the moisture content was 16.4 per cent as compared to 14.8 per cent at cutting. This rise is considered normal and is due to sweating. The temperature at this time had dropped to 72 degrees Fahrenheit. Continued and excessive blowing of from 1 to 3½ hours daily failed to lower materially the moisture content permanently; it would come down half a per cent or so and then rise again. The moisture content was 15.1 per cent on September 14 and 15.0 per cent on November 22.

Hygrometer readings taken with a hygrograph buried in the grain indicated that the relative humidity of the air in the grain rose almost to complete saturation in a comparatively short time after blowing, also that the relative humidity dropped very quickly to approximately that of the outside air as soon as blowing was started. It was thought by all that the grain would have kept perfectly after the first week with a total blowing of about 5 hours, but as this grain was a new strain of fine pedigreed seed, no chances could be taken so that probably more blowing is reported on Fig. 3 than was necessary.

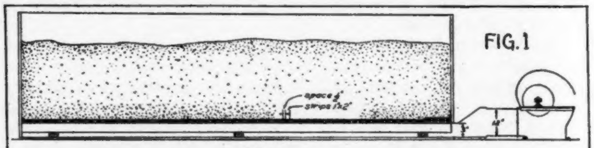
Rather careful observations were made by the plant pathology department regarding the presence of molds on this barley, a very important consideration in connection with storing grain to be used for seed. These observations indicate that in this particular case the combined grain which was artificially ventilated was in good condition and as free from molds as grain handled by the usual methods.

Germination tests by the agronomy department showed a germination of 97½ per cent before recleaning which is considered very good in view of the unfavorable season.

Grain Cut With the Binder. The inside half of the 32-acre field was cut with the binder, the bundles left lying in the windrows and the threshing machine taken to the field and the grain threshed immediately. This grain was stored in an ordinary granary, where slight heating occurred, enough that shoveling was considered necessary to avoid damage.

The first five rounds on the outside of the field were cut with the binder and shocked and threshed about a week after cutting. Due to the topography and soil conditions of the field, this strip around the outside was riper than the rest of the field. The most interesting and surprising observation of our whole experience was that this grain tested about 18 per cent moisture when it was threshed, and has averaged somewhat higher in moisture all along up until recently. This grain was stored on top of the combined grain.

Saving the Straw. Dairy farmers in Wisconsin wish to save most if not all of their straw. We baled the straw in the field, moving the straw to the baler with a Farmall tractor and push rake attachment. The swath back of the machine was so light that the push rake did not pick it up readily. The field should have been raked, preferably with a side-



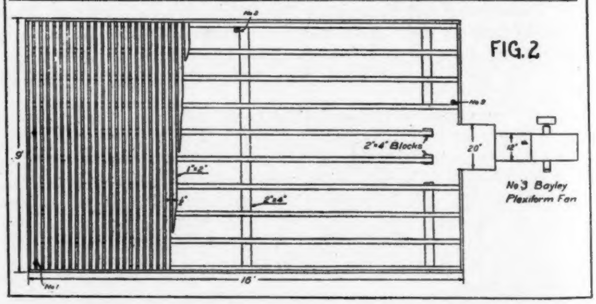
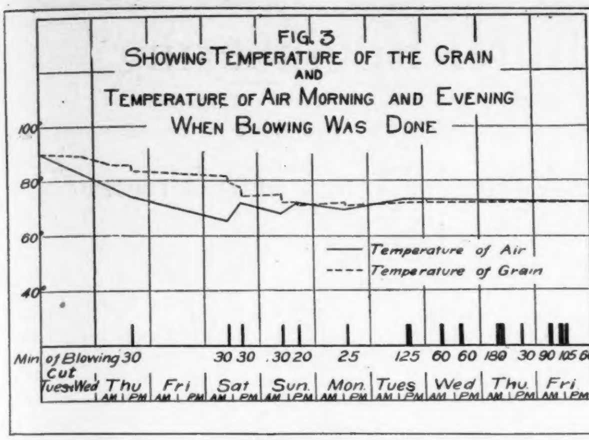


Fig. 1. (Above) Side view of granary equipped with double bottom. The slatted upper floor covered with screen wire permits thorough ventilation of the grain. A 12-inch pipe conducted the air from the fan to a rectangular opening 5 by 20 inches in the end of the granary

Fig. 2. (Below) Plan of granary equipped with double bottom. The air pressure between the two floors was observed at the three stations shown on the diagram. The readings averaged as follows: At No. 1, 1.5 inches; at No. 2, 1.4 inches; and at No. 3, 1.4 inches



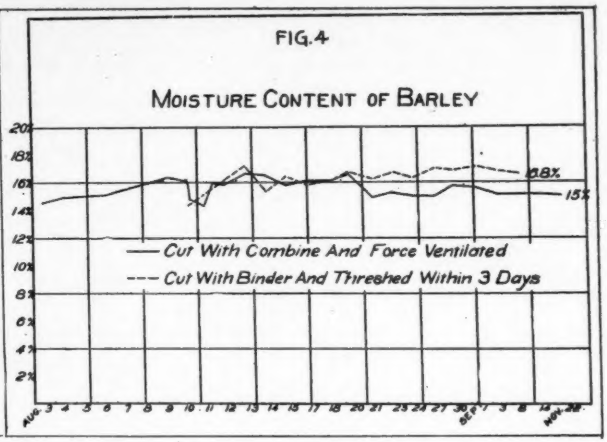


Fig. 3 (Left) The air temperature curve is constructed from readings taken at the time of blowing and does not represent a mean or average temperature. Most of the blowing was done between 7:00 and 10:00 A.M. and between 4:00 and 6:00 P.M. so as to keep the grain as cool as possible to retard molds

Fig. 4. (Right) Moisture determinations were made from composite samples, taken with a sampling tube, as nearly as possible from the same spots in the granary. Most of the samples were taken before blowing. Note the drop on August 10 where readings were taken just before and just after blowing. The relative humidity of the air ranged from 61 to 81 per cent during the blowing periods

delivery rake, throwing three or more swaths into one, and then using the push rake or a buncher on the combine.

We believe this method is preferable to loading the straw loose with a hay loader, for when it is baled it is in a compact, readily handled form and can easily be stored indoors, and will be in much more convenient form for winter use.

While no definite data was taken, it would seem that any method of saving the straw will not too seriously cut into the saving brought about by the use of the combine. In any event the grain is the main thing, and the combine saves it usually in fine condition.

Combine Improvements. The pick-up attachment whereby the grain is cut and left to lie in a swath for a period of time has been suggested as desirable for our conditions. In a favorable year this would no doubt be satisfactory, but in an unfavorable year it seems to me it will be more desirable to leave the grain standing until the entire field is ripe rather than to have it lying in the swath. I believe less damage will occur.

As a rule also the crop will be medium to fairly heavy in this part of the country and practically all if not all the straw will be run through the combine so that the machine will be working well up to capacity under ordinary average conditions.

Burton S. Harris in an article in the October, 1926, issue of AGRICULTURAL ENGINEERING (Page 352) referred to the necessity for improvement in the method of lubricating the combine. This matter can not be too strongly emphasized, as it seems that entirely too much time is lost lubricating the machine. The "one-shot system" as used on automobiles seems to me could be applied very satisfactorily and probably at a nominal expense.

It would appear to be possible and practical to make the smaller units one-man outfits by equipping them with a simple power device, either mechanical or hydraulic, for raising and lowering the platform. The control of this device could be made readily accessible to the tractor operator, and it would seem that the cost of this equipment would not be great.

It is our observation that some modifications are necessary on all machines to facilitate folding the machine for transportation and also to make it more compact for Wisconsin conditions.

Where the machine is to be moved from farm to farm over comparatively narrow and frequently winding roads, it is very essential that it can be, first, quicky folded for transportation, and, second, that it be very compact. Another change which seems to me desirable for our conditions is reel adjustment. Possibly this is not necessary as we are not trying to make a neat bundle, but our experience last year indicated that it would be at least desirable.

We believe that for our conditions a machine not to exceed the 9-foot size, and possibly the 8-foot size that can be operated somewhat faster over the ground, would be more practical.

CONCLUSIONS

1. Experiences so far have been sufficiently successful to readily warrant further investigations.

2. It is hoped that one or two machines will be used under careful observation on a larger scale in Wisconsin next year.

3. It appears so far that forced ventilation without artificial heat will usually be necessary at least with barley.

4. The cost of forced ventilation will probably be less than 1½ cents per bushel under ordinary conditions where 1000 bushels or more are handled in this way. The 1000 bushels need not all be one grain.

5. This method would seem to produce seed with as good germination and as free from molds as ordinary methods, probably better in an unfavorable year.

Discussion

Question: With regard to the moisture content of that barley, was it a uniform sample or was it taken from one certain strip?

Mr. Duffee: It was all mixed up. We took four or five samples and mixed them thoroughly. I can't make any explanation of why we had such an erratic moisture content on different days.

Question: Did you try heating the air?

Mr. Duffee: No, we used no artificial heat. But we did try it on seed corn. We dried it out in three or four days. But in the handling of seed corn, do not use too much heat or it may kill the germ. It should probably not go above 100 degrees Fahrenheit.

Now this is a simple process. One can fix the granary in a short time, and at a cost of about $60 or $80. This fan cost $78. With a small granary, a $60 fan will work out all right and one can use the same fan on several different bins.

Airplane in Land Survey Work

OF PARTICULAR interest to agricultural engineers interested in land survey work is the aerial survey operations in Canada in 1926 in which special use is made of aerial photography. The work which was started five years ago has been carried on by the Topographical Survey of the Canadian Department of the Interior, working in cooperation with the Royal Canadian Air Force of the Department of National Defence. Operations during 1926 extended over various parts of Canada. Photographs which covered an area of over 5750 square miles in the Province of Quebec were all taken in a systematic manner and show great wealth of detail which will be of service in revising the maps of the district and which will be of service to geologists, foresters, prospectors, etc. The possibilities in this should be of particular interest to agricultural engineers who have land survey work to do.

Research in Agricultural Engineering

A department conducted by the Research Committee of the American Society of Agricultural Engineers

Kinematics and Dynamics of the Wheel Type Farm Tractor*

III. Dynamics—External Forces

By E. G. McKibben[1]

TOO often the student thinks of the drawbar pull or load resistance as the only important external force acting upon a tractor. Although the drawbar pull is the all-important force from the operator's viewpoint of satisfactory accomplishment, and although it is one of the important forces from the viewpoint of theoretical mechanics, it is only one of several forces which control the tractor's kinematic and dynamic responses to the operator's demands. There are always at least two other forces, gravitation and the soil reaction.

Conventions. Unless otherwise stated the following conventions apply to all statements in this and the succeeding articles of the series:

1. The symbols used represent numerical rather than algebraic values of the distances, forces and moments being considered.
2. The front and rear axles are assumed to be parallel and horizontal.
3. The motion of the center of the rear axle is assumed to be parallel to a plane soil surface.
4. The line of action of the drawbar pull is assumed to lie in a plane perpendicular to the rear axle and midway between the rear wheels.

External Forces. Fig. 13 shows the location and direction of action of the important external forces which act in planes perpendicular to the rear axle. The inertia forces due to acceleration are included, thus reducing the problem to one, to which the principles of statics may be applied.

Gravity. (See Fig. 13.)

1. W, weight of the entire tractor.
2. W sin y_1. If y_1 is the angle between the horizontal and the plane of motion of the center of the rear axle, then W sin y_1 represents that component of W which acts parallel to the direction of motion of the center of the rear axle.
3. W cos y_1. Likewise W cos y_1 represents that component of W which acts perpendicular to the plane of motion of the center of the rear axle.

*Third of a series of seven articles. The first installment appeared in the January issue. The fourth article of the series, entitled "Dynamics—Turning Moment of External Forces," will appear in the April issue of AGRICULTURAL ENGINEERING. The material presented in these articles was obtained as the result of an agricultural engineering project of the agricultural experiment station of the University of California. It has been edited and approved by the Research Committee of the American Society of Agricultural Engineers.

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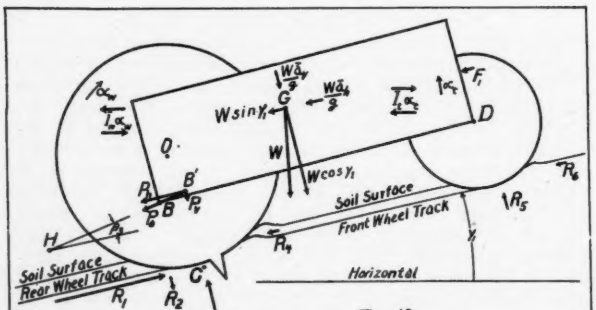

Fig. 13.

Soil Reactions. (See Figs. 13 and 14.) The reactions against the drivewheels, and the factors determining their location, direction, and magnitude, are more easily understood if they are resolved into components parallel to the direction of motion and perpendicular to the plane of motion of the center of the rear axle. In Fig. 14, OQ_1 is perpendicular to the plane of motion of the center of the rear axle, and is the instantaneous pitch radius. That is, for the given instant Q_1 is stationary with respect to the earth, and the instantaneous axis of rotation of the drivewheel, with respect to the earth, is an axis through Q_1 parallel to the rear axle. A very interesting division of a drivewheel into four parts is made by a plane through the center of the rear axle and Q_1, and the plane $Q_2Q_1Q_3$ through Q_1 perpendicular to OQ_1.

All points in plane $Q_2Q_1Q_3$ have no motion parallel to the plane of motion of the center of the rear axle. All points below plane $Q_2Q_1Q_3$ have a backward motion with respect to the earth. All points above plane $Q_2Q_1Q_3$ have a forward motion with respect to the earth. All points in plane OQ_1Q_4 have no motion perpendicular to the plane of motion of the center of the rear axle. All points back of plane OQ_1Q_4 have an upward motion with respect to the earth. All points in front of plane OQ_1Q_4 have a downward motion with respect to the earth.

1. The soil offers tractive reactions against those parts of the drivewheels, including lugs, which are below plane $Q_2Q_1Q_3$ and in contact with the soil. R_1, the resultant of these tractive reactions, will lie between the plane $Q_2Q_1Q_3$ and the lowest lug point. Except when the center of gravity, G, of the tractor is being decelerated or the tractor is traveling down grade, R_1 is the only forward acting force. Except under these conditions it will be numerically equal to the numerical sum of all backward acting or resisting forces. (See Equation 8.)
2. The soil will offer downward reactions against those parts of the drivewheels, including lugs, which are back of plane OQ_1Q_4 and in contact with the soil, except where the elasticity of the soil causes an upward movement of the soil equal to the upward movement of those parts of the wheels with which it is in contact. The magnitude of R_2, the resultant of these downward reactions, will be affected principally by the length and form of the lugs and the amount

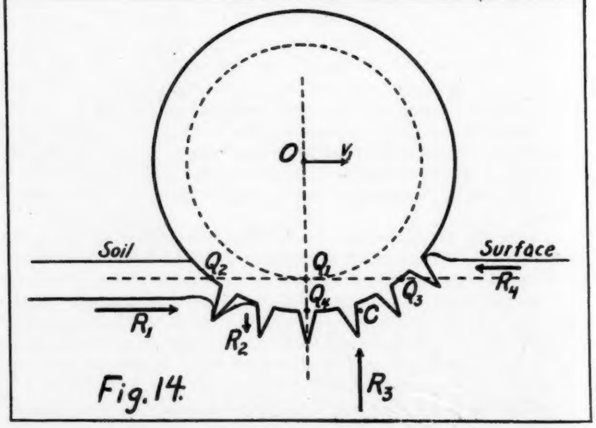

Fig. 14.

of slippage. As the slippage increases, that is, as the pitch radius OQ_1 decreases, R_2 will increase.

3. The soil offers supporting reactions, first, against those parts of the drivewheels, including lugs, which are in front of plane OQ_1Q_4 and in contact with the soil, and, second, against those parts of the wheels including lugs, which are back of plane OQ_1Q_4 and in contact with the soil as a result of an upward soil movement due to the elasticity of the soil. However, under all conditions the former is more important. Therefore, R_3, the resultant of these supporting reactions, will lie somewhere between the plane OQ_1Q_4 and the foremost parts of the wheels which are in contact with the soil.

4. The soil will offer a resistance to those parts of the wheels, including lugs, which are above plane $Q_2Q_1Q_3$ and in contact with the soil. R_4, the resultant of these resistances, will lie between the plane $Q_2Q_1Q_3$ and the surface of the soil. As slippage increases causing the distance OQ_1 to shorten and the plane $Q_2Q_1Q_3$ to rise, R_4 becomes smaller and its line of action rises. As soon as plane $Q_2Q_1Q_3$ reaches the surface of the soil, R_4 disappears.

5. The resultants of soil reactions, R_5 and R_6, are due to the weight supported by, and rolling resistance of, the stabilizing wheels, in this case the front wheels, (See Fig. 13.) The line of action of R_5 passes somewhere in front of D, the center of the wheel, and the line of action of R_6 is about the same as that of R_4. As the weight supported by the front wheels is decreased, due to a drawbar pull, grade or sudden acceleration, R_5 and R_6 are decreased. If the front wheels are lifted from the ground, R_5 and R_6 will of course become zero.

Intersection of Resultants of the Tractive and Supporting Soil Reactions. (See C of Figs. 13 and 14.) It is evident that under usual operating conditions, C will be in front of plane OQ_1Q_4, below the soil surface and above the lowest lug point. Of course, in case a lug point strikes some unyielding object such as a large stone, C might be located anywhere below the soil surface and above the lug point circumference. Also, it is probable that in actual practice the location of C is constantly changing due to changing soil conditions and the type of traction equipment commonly used. This is particularly true where the lugs are long, widely spaced, and support a large part of the tractor's weight. The location of C under many operating conditions is one of the unsolved problems of soil traction dynamics. However, as will be developed in the next article of this series, the location of C becomes very important when considering the turning moments of the external forces.

Load Resistance. (See Fig. 13.)

1. P_o is the total load resistance.

2. P_h is that component of the load resistance parallel to the direction of motion of the center of the rear axle when this component is considered as acting at B′, where B′ is the point of intersection of the load resistance with a plane through C perpendicular to the plane of motion of the center of the rear axle. If β_3 is the angle between P_o and the plane of motion of the center of the rear axle,

$$P_h = P_o \cos \beta_3 \qquad (2)$$

3. P_v is the component of the load resistance perpendicular to the plane of motion of the center of the rear axle, when considered as acting at B′.

$$P_v = P_o \sin \beta_3 = P_h \tan \beta_3 \qquad (3)$$

Inertia Forces. (See Fig. 13.) All inertia effects which can result from either rectilinear or angular acceleration can be most simply represented by two inertia forces acting through the center of gravity of the tractor and two inertia couples as shown in Fig. 13.

1. $\dfrac{W\bar{a}_h}{g}$, is the inertia force parallel to the direction of motion of the center of the rear axle where a_h is the acceleration (with respect to the earth) of the center of gravity, G, parallel to the direction of motion of the center of the rear axle.

If the acceleration, $\bar{a}_h$, is uniform and

S = change in speed of tractor in miles per hour, and

t = time in seconds required to attain a change in speed, S, then,

$$\frac{W\bar{a}_h}{g} = \frac{(W)\ (S)\ (5280)}{(32.2)\ (60)\ (60)\ (t)} \doteq (0.0455)\ \frac{(WS)}{(t)} \text{ pounds} \qquad (4)$$

Thus, if a tractor is started slowly so that the time, t, is large the force $\dfrac{W\bar{a}_h}{g}$ will be small, while if the clutch is suddenly engaged so that time, t, is very small, $\dfrac{W\bar{a}_h}{g}$ will become very large.

If by means of a uniform acceleration a tractor weighing 3,000 pounds is brought to a speed of five miles per hour in five seconds,

$$\frac{W\bar{a}_h}{g} = \frac{(0.0455)\ (3000)\ (5)}{(5)} = 136.5 \text{ lbs.}$$

If t is 30 seconds,

$$\frac{W\bar{a}_h}{g} = 22.75 \text{ lbs.}$$

However, even though the change in speed is only one mile per hour, if it is made very suddenly, for example, in 0.1 seconds,

$$\frac{W\bar{a}_h}{g} = \frac{(0.0455)\ (3000)\ (1)}{0.1} = 1365 \text{ lbs.}$$

Thus, it is evident that if the tractor is started very suddenly as when the clutch is suddenly engaged, force $\dfrac{W\bar{a}_h}{g}$ becomes of great importance; also, that if the tractor is stopped suddenly the force $\dfrac{W\bar{a}_h}{g}$ will be present but reversed in direction.

2. $\dfrac{W\bar{a}_v}{g}$ is the enertia force perpendicular to the plane of motion of the center of the rear axle, where $\bar{a}_v$ is the acceleration (with respect to the earth) of the center of gravity, G, perpendicular to the plane of motion of the center of the rear axle.

3. $\bar{I}_t \propto_t$ is the inertia couple due to the angular acceleration, $\propto_t$, of the entire tractor with respect to the earth, where $\bar{I}_t$ is the moment of inertia of the entire tractor about an axis through the center of gravity, G, parallel to the rear axle.

4. $\bar{I}_w \propto_w$, is the inertia couple due to the angular acceleration, $\propto_w$, of the wheels with respect to the tractor frame, where $\bar{I}_w$ is the moment of inertia of the wheels about the center of the rear axle.

Air Resistance. (See Fig. 13.) F_1, the air resistance offered due to the tractor's speed, is seldom of importance. This force would be of importance only when facing a high wind, but is shown to make the analysis complete

Gyroscopic Couple. In addition to the forces shown in Fig. 13 and considered above, the gyroscopic action of the engine flywheel will introduce certain forces perpendicular to the plane of motion of the center of the rear axle. If the crankshaft is parallel to the rear axle, sharp turns at high speed will result in a gyroscopic couple tending to tip the tractor sideways. If the rotation of the flywheel is clockwise when viewed from the right-hand side of the tractor, this couple will tend to tip the tractor to the left when making a right-hand turn, and to the right when making a left-hand turn. If the rotation of the flywheel is in the opposite direction of course opposite tendencies will result.

If the crankshaft is perpendicular to the rear axle, sharp turns at high speed will result in a gyroscopic couple tending to tip the tractor either backward or forward. If the rotation of the flywheel is clockwise as viewed from the front, these forces will tend to tip the tractor backward when making a right-hand turn and forward when making a left-hand

turn. If the rotation of the flywheel is in the opposite direction, opposite tendencies will of course result.

However, unless the speed of turning is very high (that is, for tractor operation), these gyroscopic forces will not be important.

If d_9 = distance in feet between lines of action of R_3 and R_5 of Fig. 13;

I_e = moment of inertia of flywheel and rotating engine parts;

M = moment due to gyroscopic forces in foot-pounds;

N_e = revolutions per minute of the engine;

N_t = revolutions per minute of the tractor in turning;

r = turning radius of center of tractor in feet;

R_7 = change in R_3 and R_5 due to M;

S = linear speed of center of tractor in miles per hour;

ω_e = angular velocity in radians per seconds of the flywheel;

ω_t = angular velocity in radians per second of turning of the tractor, then,

$$N_t = \frac{(S)\,(5280)}{(60)\,(\pi)\,(r)\,(2)} \doteq \frac{(S)\,(14)}{r} \quad \ldots\ldots\ldots\ldots\ldots (5)$$

and,

$$M = \bar{I}_e\,\omega_e\,\omega_t = \frac{(2\pi)}{(60)}(I_eN_eN_t) \doteq (.011)(I_eN_eN_t) \quad \ldots\ldots (6)$$

and,

$$R_7 = \frac{M}{d_9} = \frac{(.011)\,(I_eN_eN_t)}{d_9} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

Thus if $d_9 = 5.5$; $I_e = 3$; $N_e = 1000$; $r = 28$; $S = 2$,

$N_t \doteq \frac{(2)\,(14)}{28} \doteq 1$ = revolution per minute of tractor in turning,

and,

$M = (.011)\,(3)\,(1000)\,(1) \doteq 33$ foot-pounds.

Also,

$R_7 = \frac{33}{5.5} = 6.0$ pounds

It is evident that if N_t is very large, moment, M, and force, R_7, might become important. Since, due to the limitations of traction at both the steering rims and driving lugs, it is practically impossible to make a turn at high speed while maintaining a high drawbar pull, the gyroscopic forces will not be considered in the following discussion. However, under conditions where it is possible to make a rapid turn at the same time that R_5 is small, these gyroscopic forces should be considered.

Forces Parallel to the Direction of Motion of the Center of the Rear Axle

Since the algebraic sum of all force acting parallel to any given plane must equal zero, for the conditions shown in Fig. 13,

$$R_1 - R_4 - R_6 - P_h - W \sin y_1 \frac{W\bar{a}_h}{g} - F_1 = 0 \ldots\ldots\ldots (8)$$

It is evident that equation 8 will be affected by the position and motion of the tractor and the operating conditions.

1. If there is no wind, F_1 will be negligible.
2. If there is no acceleration, $\bar{a}_h$ will become zero causing $\frac{W\bar{a}_h}{g}$ also to become zero.
3. If the plane of motion of the rear axle is horizontal, sin y_1 becomes zero, causing W sin y_1 to become zero.
4. If the front wheels are not in contact with the soil or if the tractor has no motion, R_6 becomes zero.
5. If Q_1 of Fig. 14 is above the soil surface, R_4 becomes zero.

Forces Perpendicular to the Plane of Motion of the Center of the Rear Axle

Since the algebraic sum of all forces acting parallel to any given plane must equal zero, for the conditions shown in Fig. 13,

$$R_3 + R_5 - R_2 - P_v - W \cos y_1 - \frac{W\bar{a}_v}{g} = \text{zero} \ldots\ldots (9)$$

The position and motion of the tractor and operating conditions will also affect Equation 9.

1. If there is no acceleration, $\bar{a}_v$ will become zero, causing $\frac{W\bar{a}_v}{g}$ to become zero.
2. If the plane of motion of the rear axle is horizontal, cos y_1 will become 1, causing W cos y_1 to become W.
3. If the front end of the tractor tends to rise, R_5 will be decreased and R_3 will be increased an equal amount.
4. If the front wheels are not in contact with the soil, R_5 will become zero.
5. R_3 will tend to increase with increased drivewheel slippage.

By calculating the effect of a given adjustment or operating condition change upon the above forces, the engineer should be able to predict the tractor's kinematic and dynamic responses.

EDITOR'S NOTE: The fourth article of this series, entitled "Dynamics—Turning Moment of External Forces," will appear in the April issue of AGRICULTURAL ENGINEERING.

Needed: An Industrial Revolution in Building

IT HAS long been accepted as axiomatic among agricultural engineers that since labor and power costs constitute some forty to sixty per cent of the total expense in crop production these two items offer the largest individual, if not aggregate, opportunities for cost reduction. With that well-accepted principle in mind let us turn to the statement of Grosvenor Atterbury, of the New York Tenement House Committee, that sixty-three per cent of the cost of a house goes to putting the units together. The great possibility of cheaper housing lies in reducing the cost of assembly. According to Mr. Atterbury it can be accomplished only by larger standard units and standardized houses.

It appalls the imagination to contemplate the cost of a tractor if the procedure were to send out to the farm a crew of sufficiently skilled and correspondingly expensive men, a supply of rough castings, forgings and bar stock, and a set of blue prints, out of which the construction crew with the aid of hammers and chisels, files, scrapers and hack-saws were to make the parts and assemble them into the completed tractor. Yet this is precisely the way most building operations are conducted. The raw materials are dumped on the job and the manufacturing done by highly skilled, highly paid labor wasting its time and the owner's money by performing manufacturing operations with primitive hand tools and muscular power. It is no wonder that even so crude a structure as a private garage often costs about as much as the machine which it houses.

Probably there are many who would rebel at the idea of standardized houses, but there seems no valid objection to the proposal to use larger constructional units. Sample houses of concrete block construction actually have been constructed of about one hundred units, including the units of supplementary materials. Mr. Atterbury considers it possible to build such houses in five or six-room size out of one hundred pieces in about three days. Steel as a structural material already has made substantial strides in this direction, not only by the use of large-size units, but by the factory fabrication of component pieces in assemblies as large as are expedient under the limitations of handling and shipping. Although not welcomed with any great enthusiasm by the orthodox lumber trade, a beginning has been made in the wood building field by mail-order houses and a few well-known firms making a specialty of ready-sawed lumber and sectional knock-down buildings.

It may not devolve on the agricultural engineer to work out the details of industrialized building manufacture, but at least he can promote acceptance of its basic efficiency.

Agricultural Engineering Digest

A review of current literature on agricultural engineering by R. W. Trullinger, specialist in agricultural engineering, Office of Experiment Stations, U. S. Department of Agriculture

Convenient Kitchen, G. Gray (U. S. Department of Agriculture, Farmers' Bulletin 1513 (1926), pp. II + 30, figs. 31).—This bulletin supersedes Farmers' Bulletin 607. It contains practical information on the planning and arrangement of convenient kitchens and includes numerous working darwings.

Dissipation of Heat by Cast-Iron Water Radiators, F. E. Giesecke (Heating and Ventilating Magazine, 23 (1926), No. 6, pp. 67-72, figs. 9).—Tests conducted at the engineering experiment station of the University of Texas are reported which indicate the fallacy in the use of comparatively small pipes and the superiority of two-pipe over one-pipe water-heating systems.

Turn the Switch—Let Electricity Do the Work, T. E. Hienton and K. McMahon (Indiana Station Circular 134 (1926), pp. [1] + 16 + [1], figs. 24).—Popular information on the use of electricity in household and barnyard belt work is presented.

Terracing in Alabama, L. C. LeBron and M. L. Nichols (Alabama Polytechnic Institute Extension Circular 94 (1926), pp. 11, figs. 5).—Practical information on terracing for the prevention of soil erosion under Alabama conditions is presented.

A Contribution to the Question of the Power of the Horse's Stride [trans. title], H. Mageri (Landwirtschaftliches Jahrbuch fur Bayern, 15 (1925), No. 1-2, pp. 23-35).—A study has been made of the length of the stride of the fore and hind legs of horses when led and when driven single or double pulling an empty or loaded wagon at different gaits. Records were also taken of the weights of the horses, temperature, respiration, and pulse, as well as various body measurements, including measurements of the angles of various joints. The length of the stride was determined on moist sand, and the number of strides made in a unit of time were also noted.

The results showed that the horses normally had the longest stride when led and that the length of stride was decreased as the load was increased, but the percentage decrease was less in the animals having the longer normal stride. In teams an effect of matings with different animals was apparent. The amount of work which the horse did tended to influence the physiological measurements, but in general there was an increase in body temperature and the pulse and respiration were more rapid with work, the degree depending upon the amount of work done.

Artificial Drying of Crops in the Stack, J. Hendrick (Highland and Agricultural Society of Scotland Transactions, 5. ser., 36 (1924), pp. 141-160).—The results of a series of investigations conducted at the University of Aberdeen in Scotland on the artificial curing of hay and grain crops in the stack by blowing a blast of air through them are reported. The procedure was based on the heating of grain crops in the stack and the subsequent cooling and drying under an air blast.

The results are taken to indicate that much is yet to be learned before crops can be dried with certainty and economy by means of an artificial air blast. It is necessary to know more of the conditions under which heating takes place in stacks. It was found, for instance, that damp oats did not heat much in stacks and such heating as did take place was very uneven. It was also found that stacks must be built so that the air will pass fairly freely through all parts. As the pressure is greatest in the bottom of the stack, this will normally be the part through which the least air passes. It is therefore necessary to arrange the stack around a conical boss or in some other way to provide the thinnest layer of material in the lower part of the stack.

Another difficulty found in carrying out the process, especially in a rainy climate or in rainy weather, is that the undried material absorbs rain readily, and it is therefore difficult to dry the head of the stack in unsettled weather. Where possible, therefore, the stacks should be dried under cover.

Influence of Temperature, Fuel, and Oil on Carbon Deposition, S. P. Marley, C. J. Livingstone, and W. A. Gruse (Journal Society of Automotive Engineers, 18 (1926), No. 6, pp. 607-612, figs. 6).—Studies conducted at the Mellon Institute of Industrial Research are reported which showed that high operating temperature, the use of the more volatile fuels and a lean air-fuel mixture, and the use of lubricating oils of relatively high volatility which contain little carbon residue all tend to reduce the deposition of carbon in an internal-combustion engine.

The data indicate that the carbon values are fairly constant until the head temperature rises somewhat above 400 degrees Fahrenheit, after which there is a drop in them as the heat is increased. Deposits formed at the lower temperatures are much more asphaltic, softer, and less adherent than those formed at the higher temperatures. With evaporative or steam cooling, the head temperature was as low as or lower than the lowest with water cooling and carbon deposition was almost at the same rate as with water cooling at the same temperature.

No marked change in quantity of carbon was noted with different fuels through the series of commercial gasolines, but excessively high carbon values were obtained with heavy cleaners' naptha and kerosene. A benzol blend gave slightly more deposit than motor fuel but the deposit was softer and more soot-like. Natural gas gave only 5 per cent less deposit than commercial gasoline. This is taken to indicate that in a 12:1 mixture a good average grade of gasoline plays a very small part in the deposition of carbon.

In runs simulating ordinary cool weather operation, with a 10:1 ratio of air and ordinary gasoline, lubricating oils distilled from Pennsylvania and Mid-Continent crudes gave considerably higher carbon deposits than oils derived from Gulf Coastal crudes.

Under conditions simulating summer operation with a mixture ratio of 12:1 the carbon deposit with Gulf Coastal oil was only half of that with Pennsylvania oil, while that from Mid-Continent oil was midway between. Carbon deposits from Gulf oils were in general dry, powdery, and friable, while those from Pennsylvania oils were very hard and adherent over the hotter areas and sticky and asphaltic over the cooler areas of the combustion chamber. It is considered probable that the belief that there is a connection between so-called heat resisting properties of an oil and its desirability as a lubricant is erroneous. The results indicate that oil which will leave the least residue upon evaporation from the metal surfaces will give the least trouble from carbon deposition.

Stationary Spray Plants in California, B. D. Moses and W. P. Duruz (California Station Bulletin 406 (1926), pp. 29, figs. 13).—This bulletin is a contribution from the divisions of agricultural engineering and pomology of the station and the stationary spraying subcommittee of the California Committee on the Relation of Electricity to Agriculture. It is the first of a series planned to report the results of investigations conducted jointly by the station and the committee.

A stationary spray system consists of a central pumping station and pipe lines laid systematically throughout the orchard with outlets at regular intervals to which hose are attached for spraying the trees. The principal advantages of stationary spray plants were found to be that spraying may be done when necessary in spite of adverse soil or weather conditions, and that pests requiring quick action may be speedily controlled.

There was found to be a possibility of combining the advantages of the portable sprayer and the stationary spray plant by piping sections of the orchard that would be benefited and using the portable sprayer for supply and power. In this arrangement the portable rig becomes the pumping station for the permanent piping system, and at other times is available for spraying parts of the orchard where there is no pipe line.

A bibliography is included.

Lubricating Value as Related to Certain Physical and Chemical Properties of Oils, L. W. Parsons and G. R. Taylor (Industrial and Engineering Chemistry, 18 (1926), No. 5, pp. 493-496, figs. 5).—A brief review of the theory of lubrication is given together with a discussion of the application of this theory to a few special cases, with particular reference to the value of certain tests.

Book Reviews

"The Small Home" is the title of a book written by William Draper Brinckloe and published in 1924 by Robt. M. McBride & Co., New York. It is of particular interest to agricultural engineers because of its constant reference to farm needs and practices. In writing it the author has drawn largely from his experiences in conducting home planning contests for the "The Ladies' Home Journal," "The Farm Journal," "People's Popular Monthly," and other magazines. An attempt has been made to cover the entire scope of the subject from selecting the site (Chapter 1) to framing the picture (Chapter 17) and sixty house plans (Chapter 18). Naturally, to discuss such a broad field in its entirety and within the covers of an ordinary sized book has required that the author skim the material, presenting only essentials and items which particularly affect the lay builder. For the most part though these are given in a most interesting manner. In the last chapter a very good presentation of house plans has been adopted. A perspective, floor plans and a brief written description of each plan is shown on two facing pages. In the latter is included the floor area and a cost estimate based on this area. The houses shown range from \$1200 to \$12,000 in their various costs. Many of the plans are designed especially for the farm. One feature which might well have been omitted is the superficial paragraph devoted to the farm barn. Particularly does this refer to a very ordinary plan for a barn. An excellent idea is incorporated in the advertisement that complete working blue prints of any of the plans are available from the publishers at a cost of \$2.00 each—J. D. Long.

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RAYMOND OLNEY, Editor

The Committeemans Burden

NOT only the American Society of Agricultural Engineers as such, but the art and the profession which it represents, move forward or stand still, marking time, according to the pace set by its committees. Its progress is largely given into the keeping of the committeemen whose function is to lead, to plan, to correlate, to crystalize, to codify. In a committee appointment there is an implied compliment to a man's reputation for talent and faithfulness, but honor is tentative until definitely earned by duty creditably discharged.

The tangible contributions of this Society to agricultural engineering are largely a measure of team work and individual hard work by committeemen. Results of individual work presented in the form of papers may be likened to the larger pieces of building material; discussion at the meetings may be thought of as hardware and trim; but the planning of the work and its putting together into an organized, useful structure depend on the architect and artisan—the chairman and members of each of the several committees.

With increase in the size of the Society, the organization of divisions, and the growth in diversity and complexity of the subject matter with which we deal, it is increasingly necessary that committee work shall proceed according to schedule; that progress reports be made regularly and promptly; and above all that committee appointments be accepted and discharged with military seriousness and precision. While it is true that the Society is a voluntary organization in which discipline in the strict sense is neither possible nor desirable, it is essential that we voluntarily observe a sort of quasi-discipline as a means to orderly, correlated, substantial progress.

With reasonable allowance for variation in the human factor, a survey of the Society's history and achievement will show a fair coefficient of correlation between the firmness of organization, and observance of schedule in work and progress reports, within a committee and the measure of its results. In these points, more than in any other one thing, lies the explanation of differences in achievement among the various phases of Society work.

More than ever before, with the geographical handicaps of our far-flung membership, it is essential that every committee assignment be regarded as a twelve-month job—begun promptly, pursued consistently, reported regularly and organized well for final presentation.

An Engineering Dean's Veiw

DURING the past decade agricultural engineering has grown rapidly in recognition and prestige. This comparatively new branch of the engineering profession, since its inception nearly twenty years ago, has been blessed with a sturdy, far-seeing group of pioneers. They have been quietly but none the less persistently forging ahead, until today the leaders in both agriculture and engineering are more and more appraising agricultural engineering at its true worth.

One of the most significant statements, from the standpoint of the agricultural engineer, that has come to our attention and which every member of the profession will value most highly, is that contained in a letter to Prof. Dan Scoates, head of the department of agricultural engineering of the A. & M. College of Texas, from Mortimer E. Cooley, dean of the college of engineering at the University of Michigan.

Dean Cooley is a national figure in engineering circles. He is a past-president of American Engineering Council and the American Society of Mechanical Engineers. His service to the engineering profession and to the country as an engineer is outstanding. His standing in his profession and his wide experience in the engineering field, together with his clear vision of the future of engineering, makes his views of particular importance and significance. We quote from Dean Cooley's letter as follows:

" . . . . . . Probably my views (on agricultural engineering) are in a measure due to my nineteen years on a farm where I had to do all the things farmer boys did sixty years ago. Had we been able to look ahead then as we can look backward now, I am sure the story of the farm would be very different. . . . . .

"Looking backward half a century I have often thought that had I my life to live over again and could choose I would have gone to teach in an agricultural and mechanical college instead of in a university. Notwithstanding the field of engineering in which I have wrought is very great and the results have been commensurately great, the field in agriculture, as I see it, is even greater. It has afforded opportunities in engineering which in their bearing on the welfare of the nation must stand first in importance. Nothing could be more important than feeding and clothing a people.

"I am not overlooking the many things accomplished in the general field of engineering which have aided the agriculturist—indeed have been vital to the development of the farm—such as transportation for instance; nor am I forgetting the internal-combustion engine, means of communication and other things. But quite apart from them and having to do with the production of things to be transported, having to do with life on the farm, there are opportunities for the engineer that are only beginning to be realized. When the awakening comes the tide of migration from farm to city will turn and sons of the soil will again come into their heritage.

"Probably it was inevitable that fifty years should in some measure be lost, as we have been land rich and not obliged to make the most of it. So have we been rich in other natural resources and have used them with no thought of the future. But soon now, in another generation or so, we shall begin to feel the pressure of population. New problems will be upon us. The present policy of expansion will be supplanted by one of conservation. Engineering education, all education, must and will respond. If we shall have learned this lesson in fifty years, and shall heed it, the time will not have been lost. The nation is still young.

"The foregoing is more extended than what I said. Yet it is only a part of what could be said. Some day I may try to write out my thoughts at length. I should like to. There are the problems peculiar to the agricultural engineer, in which I imagine chemical engineering plays even a more important part than mechanical engineering. It is a great and important field is agricultural engineering, and so closely tied to agriculture that it belongs primarily to our colleges of agriculture and mechanical arts. Theirs is the responsibility to foster and encourage a branch of engineering which I feel certain will in the future outweigh some, if not most, or even all, of the other branches in importance."

"(Signed) MORTIMER E. COOLEY"

The Engineer in Public Office

MARK SULLIVAN, the well-known newspaper writer, in an article published some time ago in the Birmingham (Alabama) "Age-Herald", discussed the desirability of placing engineers and scientists in important public offices. By way of introduction he observed that of all the nations involved in the World War, the United States has been the only one to escape profound general depression, and has, instead, maintained a high level of general prosperity notwithstanding the exceptions in agricultural and textile lines. He says that investigators—economists, scientists, government officials, bankers, etc.—from these other countries have come to learn, if possible, the secret of our success, and that after giving due weight to other factors, they pretty well agree on Herbert Hoover as the answer, both as to his outstanding contribution as an individual, and even more as the type and symbol of the thing which has maintained American prosperity in the face of the post-war reckoning.

Mr. Sullivan attaches much significance to the fact that Mr. Hoover is practically the first man who came into big-league politics from a background of pure science and practical engineering, and ventures the offhand opinion that he is the first American who ever came into the cabinet with the right to set down after his name the letters "C.E." or "M.E." Going on, he points out that in the past we have had many business men in politics—rather too many of a certain kind. They were the "accumulators, money changers, traders, business men in the older sense, those who thought of wealth in terms of accumulation rather than diffusion. More of them thought of wealth as coming from the tariff, or from franchises of one sort or another, than from the perfection of science." Again he says, "More and more the problems of politics are interwoven with the problems of science and of applied science. If politics be balanced against science, the relative importance is utterly clear—and quite devastating to the self-esteem of the politician . . . . . . La Follette raised many issues, most of them having to do, directly or ultimately, with 'dividing up' material goods. But if all the proposals La Follette made had gone into effect, would the aggregate of them have brought as much material good to the average man as did the efforts of Henry Ford, in perfecting an inexpensive automobile and organizing the distribution of it? . . . .

"Never before did any one remotely resembling Hoover have political power. No president ever thought of looking for cabinet timber in the fields where Hoover came from. Even in the Department of Commerce the man who preceded Hoover was a country lawyer, a lame-duck congressman from rural Missouri. That Secretary of Commerce was appointed by Woodrow Wilson, who was more likely than most presidents to understand the relation of science to commerce, in the sense that commerce means the diffusion of goods. Until Hoover came into public life the whole political habit of the nation was to overlook such men . . . . . Our political lines of thought never ran that way."

Throughout the article Mr. Sullivan largely neglects politics as a process of promising panaceas and getting votes, and confines himself to the possibility of the holders of public office, as demonstrated by the exceptional cases of which Secretary Hoover was taken as an example, to apply efficient methods of management and technique on the large scale involved in public affairs.

Saving Money on the Farm Lumber Bill

THE Nation's annual building bill for small and medium wooden dwellings and barns and other wooden farm structures is approximately two billions of dollars, according to the report of the subcommittee on construction of the National Committee on Wood Utilization, of which Secretary of Commerce Herbert Hoover is the chairman. The major portion of this construction is on farms and the cost, the committee claims, could be reduced by tens of millions of dollars, if the consumer would abandon the habit of buying long length lumber exclusively and then cutting one-fifth or more of it up into short lengths called for by the plans. This is due to the fact that many of the sawmills of the country offer these short lengths which are of equal quality with the longer lengths for from 15 to 35 per cent below the price of the latter. They are able to market, however, only about one fourth of what average timber would produce if fully utilized.

The report of the construction subcommittee makes a careful survey and analysis of plans for nine types of small and medium dwellings, one, one and one-half and two stories high, and of thirty-five other farm structures, including barns, milk houses, grain storage buildings, and hog and poultry structures. Many of these plans were from agricultural engineering sources in the U. S. Department of Agriculture and from the engineering departments of a number of state agricultural colleges, and lumber bills were furnished with them. The tabulations analyze these and show what percentages of the total lumber were specified in lengths of 7, 6, 5, 4, and 3 feet. (Commercial lengths vary by even feet only on long lumber, but by odd and even feet from 7 feet down). On these bills considerable long lumber had been specified to be cut into short lengths at the job; and new lumber bills were figured which listed all the short pieces of the plans in the short commercial lengths that would cut them. The right half of the tabulation lists these "permissible" percentages of shorts, separated by lengths from 1 to 7 feet; and on dwellings further dividing into framing material, common boards and trim, and subdividing by specific uses.

The original lumber bills specified the common boards (for sheathing and subfloors) only by board feet and not by specific lengths; and in the finished material specified the window and door trim by cut lengths, so that analysis of use of short material for comparison with the revised bills was useful only on the ten kinds of framing material. This averaged 15.8 per cent of the total lumber specified in 7-foot and shorter for the dwellings, as against 19.59 per cent of "permissible" use indicated by the revised lumber bills. The new bills show also a permissable use of 26.13 per cent of the short lengths in the boards used for sheathing and subfloors, and of 51.49 per cent in the finish lumber.

The tabulation of barns and other farm structures showed an even larger opportunity for the use of short lengths, which the original lumber bills fell far short of specifying.

Because the commercial lengths are not the exact lengths required, there is usually one waste end cut off from each piece; and there are more such waste ends in a thousand feet of short lumber than of long, because there are more pieces. On the other hand, the waste end of the long board may be anything up to 2 feet and is 1 foot or less on the short board, which largely compensates. Another theoretical argument is that short stock takes more handsaw cuts than long, but this seems to infer that because long boards trimmed on the main saw trimmer at great speed are not good for use without retrimming, the short lengths will come that way also. As a matter of fact, nearly every short piece will have at least one end trimmed by a cut-off saw instead of at the green lumber trimmer, and if it is dressed or further worked this trim occurs after both seasoning and working; and such ends will generally be good for use in framing or any other unexposed joinery.

The construction subcommittee of the National Committee on Wood Utilization consists of twenty-nine members, fourteen of whom are either architects or engineers, the balance consisting of representatives of a number of great national organizations, including the American Society of Agricultural Engineers. Copies of the report can be secured from the Superintendent of Public Documents, Washington, D. C. ("The Marketing of Short Length Lumber", 28 pages, 13 illustrations, 7 tables. Single copies 10 cents.)

A. S. A. E. and Allied Activities

Southern Section Meeting

AGRICULTURAL engineering development has received a real impetus in the southeastern states as a result of the first meeting of the Southern Section of the American Society of Agricultural Engineers held at Atlanta, Georgia, February 2 and 3, in connection with the annual meeting of the Southern Agricultural Workers Association. The newly organized Southern Section of the Society includes the territory east of the Mississippi and south of the Ohio and Potomac Rivers, not including the states of Virginia and West Virginia.

The various sections comprising the Southern Agricultural Workers Association are made up almost entirely of sections of national technical organizations. The organization of the Southern Section of the Society and its close cooperation with the Southern Agricultural Workers Association supply one of the missing links in the latter organization, namely, a section specializing in agricultural engineering. This cooperative arrangement is a most fortunate one, inasmuch as it tends to strengthen agricultural engineering in that section of the United States and, at the same time, encourages closer cooperation between agricultural engineers and other agricultural scientists in the solution of agricultural problems involving engineering.

The morning sessions of February 2 and 3 were held jointly with all sections of the Southern Agricultural Workers Association. The programs for these sessions featured the following subjects: (1) Economic waste through lack of coordination of agriculture, commerce, and industry; (2) waste resulting from the lack of effective contact with investigations planned for a permanent program for southern agriculture; and (3) the best method of getting results of economic research in the state systems of education in the South.

The A.S.A.E. program for the afternoon of February 2 featured the subject, entitled "Engineering Methods of Elimination of Waste in Agriculture." The utilization of machinery as a means to this end was discussed by J. T. McAlister, Clemson College; soil improvement by J. T. Copeland, Mississippi A & M College, and the utilization of storage buildings by S. P. Lyle, Georgia State College.

A 100-word report made by the agricultural engineering section to the general meeting of the S.A.W.A. on the contribution of agricultural engineering to the program of elimination of waste in agriculture, included the following main points:

1. To conserve the natural and applied fertility of the soil through the control of erosion.
2. To improve farm land in tillage through reclamation by clearing, stumping, and drainage.
3. To apply power and machinery effectively for the conservation of man labor and greater capacity per man.
4. To conserve farm products by proper curing and storage facilities.
5. By providing adequate buildings for the housing of livestock.
6. To decrease the energy required in the maintenance of the home by the use of mechanical power, conveniences, and well-considered plans.

This report was drafted by a committee consisting of D. G. Carter, chairman; J. T. McAlister, E. C. Easter, and J. T. Copeland.

The afternoon program of February 3 included a paper on farm machinery work by M. L. Nichols, Alabama Polytechnic Institute; rural electrification progress in the South by E. C. Easter, Alabama Polytechnic Institute; farm house research in the South by D. G. Carter, University of Arkansas; nonprofessional agricultural engineering education by W. C. Howell, Mississippi A & M College; and professional agricultural engineering education by C. E. Seitz, Virginia Polytechnic Institute.

A dinner and business meeting of the Southern Section was held the evening of February 2. At the evening meeting the following officers of the section for the ensuing year were elected: Chairman, J. T. McAlister, Clemson College, South Carolina; first vice-chairman, S. P. Lyle, Georgia State College; second vice-chairman, D. S. Weaver, North Carolina State College; secretary-treasurer, W. C. Howell, Mississippi A & M College.

The next meeting of the section will be held at Memphis, Tennessee, in February, 1928, in connection with the regular annual meeting of the Southern Agricultural Workers Association. There is a possibility that this will be a joint meeting of the Southern and Southwestern Sections of the Society.

The following resolution relative to the establishment of a separate bureau of agricultural engineering of the U. S. Department of Agriculture was passed during the meeting of the Southern Section; a similar resolution endorsing the same idea was also passed by the Southern Agricultural Workers Association:

WHEREAS, the present agricultural conditions throughout the southern states are largely due to the lack of improved farm machinery and larger power units in producing farm crops, and

WHEREAS, a recent survey conducted by the U. S. Department of Agriculture of research in mechanical farm equipment has shown a great need for further study along such lines, and

WHEREAS, the engineering phases of agriculture are not receiving adequate attention in agricultural colleges, experiment stations, and the U. S. Department of Agriculture, therefore be it

RESOLVED that the Southern Section of the American Society of Agricultural Engineers, in convention assembled, bring these facts to the attention of the Secretary of Agriculture and urge upon him the importance of recommending to the Congress the establishment of a separate bureau of agricultural engineering in the United States Department of Agriculture, in order that the scope of this very important work may be enlarged to meet the needs of agriculture, and be it further

RESOLVED that a copy of these resolutions be sent to the Hon. William M. Jardine, Secretary of Agriculture, and a copy spread on the minutes of this meeting.

Ten Million to Fight Corn Borer

A $10,000,000 intensive campaign under the direction of the Secretary of Agriculture for the control of the corn borer which threatens to spread through the corn belt has been authorized by the joint Congressional resolution signed by the President February 23 supplementing the corn borer control act. The act provides for control work in seventy-six counties in New York, Pennsylvania, Ohio, Michigan, and Indiana, in which the corn crop is threatened by the borer. It is estimated that 2,500,000 acres of corn land in these states will be included in the clean-up.

The act provides that the funds appropriated shall be used for such clean-up measures as are necessary in addition to those farm operations normal and usual in each locality. Up to May 1, efforts will be centered on obtaining the cooperation of farmers in a voluntary clean-up of the infested area. Immediately following May 1 steps will be taken to complete the clean-up under the regulatory powers of the act. The provisions of the act will be administered through the Bureau of Entomology of the Department of Agriculture.

The expenditure of funds appropriated by the act is dependent on the passage of necessary supplementary legislation by the legislatures in the five states, all of which are now in session. It is contemplated by the act that the clean-up of the borer will be conducted by the Department of Agriculture in cooperation with the state departments of agri-

culture. State authorities are being urged to push the necessary state legislation to early enactment. Delay may make it impossible to carry out the proposed control measures effectively.

Walker to Direct U.S.D.A. Farm Equipment Research Survey

THE Secretary of Agriculture announces that the services of H. B. Walker, professor of agricultural engineering and head of the department at the Kansas State Agricultural College, have been secured to direct the program of research in mechanical farm equipment undertaken by the Department's division of agricultural engineering more than a year ago.

Prof. Walker's duties will include the task of establishing and encouraging specific investigational work in mechanical farm equipment in the state experiment stations now supplied with funds and personnel and to conduct experimental research; visit state experiment stations to determine how agricultural engineering research will fit into existing agricultural programs; assist in working out preliminary plans for future projects; conferences with research specialists who are now doing constructive investigational work for the purpose of encouraging them to expand their own activities and correlate their activities with similar studies under way or contemplated at other institutions; and visit the experimental laboratories of implement industries to encourage a correlated and cooperative program of efforts throughout the nation.

H. B. WALKER

Recognized as one of the country's leading agricultural engineers, Prof. Walker is especially well qualified to carry out such a program. He is a native of Illinois, and received his early education in that state. He was graduated from Iowa State College in 1910 with the degree of bachelor of science in civil engineering, and received his masters degree in civil engineering from the same institution in 1920. He has held several important positions in civil and agricultural engineering work, and from September 1917 to July 1919 served as a captain of engineers in the U. S. Army; with the exception of two years on military leave he served as drainage and irrigation engineer with the extension division of the Kansas State Agricultural College, 1910 to July 1921. Since the last named date he has filled the position of professor of agricultural engineering and head of the department of agricultural engineering at that institution until the present time. In addition to these positions since 1910 he has served as assistant state highway engineer, state irrigation engineer, associate professor of civil engineering, special consulting engineer of the U. S. Reclamation Service, engineer and later a member of the Kansas Water Commission, state supervisor of the Kansas Committee on the Relation of Electricity to Agriculture, and consulting engineer of the State Fish, Game, and Forestry Commission.

In addition to being a member of the American Society of Agricultural Engineers he is a member also of the American Society of Civil Engineers, Kansas Engineering Society, and Society for the Promotion of Engineering Education. Prof. Walker is also author of a number of important publications.

Prof. Walker served the American Society of Agricultural Engineers as president from 1924 to 1925, and in that capacity represented the Society as a member of the assembly and administrative boards of American Engineering Council from 1925 to 1927. He is at present chairman of the College Division of the Society and has served continuously as chairman of the Committee on Cooperative Relations which functions jointly with a similar committee from the National Association of Farm Equipment Manufacturers, and other industries allied to the agricultural-engineering field. In addition he has served the Society on a number of important committee appointments.

The Short Length Lumber Report

Secretary, A.S.A.E.:

REPLYING to your letter dated January 11, I think you will be interested to know that we have succeeded in interesting retail lumber dealers in all sections of the country in providing for the distribution of short-length lumber. Most of the annual conventions of retail dealers were held during January and February, and we have been on the programs of practically all of these conventions and have been given assurance that the lumber distributor will join hands with the producer and consumer in this national effort to develop a demand for softwood lumber that is less than eight feet long.

The United States and Canada are the only countries where short-length lumber is not in general demand, and in the course of time there is no doubt but that economic pressure will force its utilization here as it has done abroad. If we can anticipate this forced short-length utilization, the lumber consumer will be directly benefitted for he will be able to purchase short lengths at a price considerably below that asked for the standard long length lumber. Furthermore, national interest in this problem at the present time will postpone the day when the price of long length lumber will be increased, for fuller utilization of our lumber resources will reduce average manufacturing costs with resulting benefit to the consumer of lumber.

The National Committee on Wood Utilization in its short-length lumber report gives the public assurance that there is a real dollar-and-cents saving to them in the use of short-length lumber. That is why we are anxious to have the facts contained in our bulletin brought to the attention of all classes of lumber consumers. The tables contained in the report give the consumer a fairly definite idea of the amounts of short-length lumber that go into the various types of houses and farm buildings and give a general idea of the percentage of a total lumber bill which can ordinarily be bought in lengths less than eight feet. I believe there are about six million farms in the United States. Assuming that only $80 per year per farm is invested in building, the cost of such building would approximate 500 million dollars annually. If short-length lumber were used wherever it could be used, an average of between five and ten million dollars could be saved on this building investment.

Lumber is a product of nature and the grading rules admit a greater number of defects in long lengths than in short lengths, therefore by buying short lengths the farmer obtains better quality for his money than if he buys long lengths.

The utilization of short-length lumber is of the greatest importance to the farmer not only in his capacity as a consumer, but also because the farmers of the United States possess 140,000,000 acres of forest lands which represents about one-third of the forests of the country.

If a start in the direction of interesting the public in this problem is not made nothing will be done. Something must be done if we are interested both in postponing the day when lumber prices in general will be increased and in providing for the perpetuation of our forest resources. Commercial reforestation depends upon more complete utilization of our standing timber. Business men obviously will not be interested in growing a crop of trees if, when grown, only 35 per cent of the product will be used.

Present utilization practice is supported by the habit and custom of ten generations and for the most part these habits are wasteful. They are wasteful because they originated in the days of plenty on a new continent. Habits of a single lifetime are hard to break and those of ten generations are ten times more persistent. We have emerged from the pioneer period and are beginning to produce lumber to meet current demands, and while 35 per cent utilization went unnoticed, so far as the consumer is concerned, so long as we were dealing with virgin forests, but it cannot escape attention when we begin to grow forests involving large capital investments.

I am sure that you are interested in the aims and purposes of this Committee and I hope that we may count on your cooperation in having the information which the Committee develops brought to the attention of your membership.

DUDLEY F. HOLTMAN

Assistant Director, National Committee on Wood Utilization, U. S. Department of Commerce

P.S. A special rate on our short-length lumber report of $4.00 per hundred has been arranged when quantities of one hundred or more copies are ordered. The report has been available only a little more than one month and almost twenty thousand copies have been sold.

Kinsman Joins Western Harvester

ANNOUNCEMENT of the appointment of C. D. Kinsman, (Mem. A.S.A.E.), senior agricultural engineer, Division of Agricultural Engineering U.S.D.A. Bureau of Public Roads, as sales engineer, is made by the Western Harvester Company, Stockton, California, manufacturers of "Holt" combined harvester-threshers. Mr. Kinsman took up his new duties on February 1, with headquarters at the general offices of the company at Stockton.

C. D. KINSMAN

Mr. Kinsman is a native of Nebraska and received the major part of his education in that state. He was graduated from the University of Nebraska in 1912, receiving the degree of bachelor of science in agricultural engineering. This was the first class to receive that degree at Nebraska. He afterwards attended Purdue University, receiving his master's degree in 1916.

From 1912 to 1916 he taught farm machinery and drainage work at Purdue, and from 1916 to March 1918 he was engaged in agricultural engineering extension work in Indiana. He then left Indiana and became associated with the agricultural extension staff at the University of Nebraska. From 1919 to 1922 he operated a grain and livestock farm in Nebraska, and, in addition, carried on a private engineering practice.

He was engaged by the U.S.D.A. Division of Agricultural Engineering in July, 1923, to make a national farm-power survey requested by the Committee on the Relation of Electricity to Agriculture. He remained in Washington as senior agricultural engineer in charge of farm machinery and farm power investigations until January of this year. Mr. Kinsman is author of several bulletins on farm power and machinery and his work in this field is of an outstanding character.

Elected to membership in the American Society of Agricultural Engineers in 1914. Mr. Kinsman has been prominently identified with several important committees of the Society, principally along power and machinery lines. Mr. Kinsman's work in the agricultural engineering field is an outstanding contribution to the advancement of the profession.

Agricultural Engineering Association Formed in Michigan

AS AN indication of the rapidly increasing interest in agricultural engineering among farmers is the organization during Farmers' Week at Michigan State College, during the first week in February, of the Michigan Agricultural Engineering Association.

The primary object of this organization is to encourage higher efficiency and improved farm practices through the more extensive application of engineering to the agricultural industry. Membership in the association will come largely from farmers who are primarily interested in engineering as a means of solving many of their every-day farm problems. Membership will also include agricultural engineers, representatives of manufacturing concerns selling equipment and materials to the farmer, as well as other groups having a particular interest in agricultural engineering. The association will actively interest itself in solving the many engineering problems constantly arising on the farm, particularly in the more efficient use of power on the farm and in the farm home.

The association will be controlled by a board of seven directors from whom the officers are selected. The officers and other directors elected at the recent meeting include E. S. Thompson, farmer, Remus, Michigan, president; H. H. Musselman, professor of agricultural engineering, Michigan State College, vice-president; L. F. Livingston, extension specialist in agricultural engineering, Michigan State College, secretary-treasurer; Bert Knapp, power farmer; A. E. Hurd, Lansing manager, John Deere Plow Company; F. E. Fogle, professor of agricultural engineering, Michigan State College; and I. D. Charlton, agricultural engineer.

Farm Machinery Study Suggests Improvements

MORE than four hundred specific suggestions for experimental research relating to mechanical farm equipment have been listed in a report just issued by the Department of Agriculture. This report is the result of a survey of research in mechanical farm equipment completed recently by J. Brownlee Davidson, senior agricultural engineer of the Bureau of Public Roads, under the direction of an advisory council representing the National Association of Farm Equipment Manufacturers, American Society of Agricultural Engineers, and the United States Department of Agriculture. The Department of Agriculture, upon recommendation of the advisory council, will follow up the survey with a study of the means and methods by which agricultural engineers may participate in working out the problems developed. No additional survey work is contemplated, but it is expected to develop concrete plans for investigational work in this particular field which will become the foundation for more extensive research.

The specific suggestions may be classified in four groups as follows:

(1) Those of a basic nature in which the scientific soundness of various farm operations involved in production, such as plowing or other forms of tillage, are questioned

(2) Those based on a premise that present methods of farm operations apparently are sound because they have been established through long practical experience, but concerning which the efficiency and economy of present practices are questioned

(3) Those which involve the individual efficiency of farm machines, such as the power required to grind a bushel of grain as influenced by the fineness of grinding, moisture content and method of reduction

(4) Those which call for new machines or modifications of present machines to meet farm requirements in particular localities, or for specific crops, such as the development of a delinting machine for cotton, or a thinning machine for sugar beets

The survey indicated, however, that, with the exception of a rather limited number of our agricultural experiment stations, very little emphasis is now being placed on research and investigational work relating to mechanical farm equipment. Although there is at present a total of one hundred thirty-five projects related in a general way to this particular field, these constitute less than two per cent of the total agricultural projects now being studied by our state agricultural experiment stations.

The results of the survey have stimulated widespread interest in these problems, and the administrative officers of experiment stations and engineers are thinking more concretely than ever before about the place of agricultural engineering investigations in experiment station work, and how they will fit into the older established lines of agricultural research. The task is not an easy one, for it involves the introduction of engineering factors into the established regime of agricultural research. Station directors, however, have generally signified a willingness to undertake such research as rapidly as funds permit and as soon as properly trained technical personnel is available to analyze the important mechanical equipment problems relating to their major programs of agriculture.

The rapid increase in the use of mechanical farm equip-

ment by agriculture has developed many problems which a decade or two ago were practically unthought of, or which were at that time relatively unimportant. Modern agriculture has become an industry in which machinery is of primary importance. These machines must be able to meet the most exacting requirements of the agriculturist not only for quantity and quality of production, but for weed eradication and for insect and plant disease control. So exacting are these requirements becoming that manufacturers of modern farm machines are finding it difficult to meet intelligently the increasing needs of the agricultural industry for specific machines. New data and methods are needed for both the design and operation of machines which must be correlated more closely than ever before with the most advanced practices in agricultural science.

The advisory council believes this is a phase of agricultural investigation which merits the same careful study as that now given to plant breeding, insect control, soil fertility, animal diseases, and other basic agricultural problems. It is expected the 1927 program, which has been approved by the United States Department of Agriculture, will be the means of starting the foundation work for more extensive investigations in mechanical farm equipment which will be of direct benefit to the manufacturer of farm equipment as well as the farm operator.

The Division of Agricultural Engineering of the U.S.D.A. Bureau of Public Roads, to which this program of research in mechanical farm equipment was committed by the Secretary of Agriculture, has secured Prof. H. B. Walker, head of the department of agricultural engineering, Kansas State Agricultural College, as a consulting specialist to follow up the survey work completed last year.

Prof. Walker's duties will include the task of establishing and encouraging specific investigational work in mechanical farm equipment in the state experiment stations now supplied with funds and personnel to conduct experimental research; visits to state experiment stations to determine how agricultural engineering research will fit into existing agricultural programs, and to assist in working out preliminary plans for future projects; conferences with research specialists who are now doing constructive investigational work for the purpose of encouraging them to expand their own activities and to correlate their activities with similar studies under way or contemplated at other institutions; and visits to experimental laboratories of implement industries to encourage a correlated and cooperative program of effort throughout the nation.

Agricultural Engineering Emphasized

THE introduction of the report of the director of the Wisconsin Agricultural Experiment Station for the period 1924 to 1926, issued as Bulletin No. 388, entitled "Gleanings from Science," contains a significant statement on agricultural engineering. A review of the work in agricultural engineering at that station appears first in the director's report immediately following the introduction, which is unusual in reports of this kind, but which is significant in that it indicates the growing importance of agricultural engineering and the recognition which it is receiving. The statement referred to is as follows:

"The intelligent use of farm machinery, more especially the modern labor-saving devices and electrical appliances, constitutes a basic means of shortening farm labor hours and providing time for other things, as well as insuring necessary production in spite of the reduced quantity of available farm labor. The College of Agriculture is keenly interested in this field of work and is glad to be able this year to emphasize certain findings which may be of much importance in contributing to the ultimate solution of the problems of farm life.

A Correction

SPECIAL attention of readers of AGRICULTURAL ENGINEERING is called to an error in the article, entitled "Does Your Carburetor Air Inlet Face Forwards?" by A. H. Hoffman, on page 31 of the February issue. In the table accompanying this article the figures in the fourth and fifth columns denote the amount of dust caught in "grams" instead of in "grains" as stated.

Assistant Secretary Appointed

ANNOUNCEMENT is made by Raymond Olney, secretary of the American Society of Agricultural Engineers, of the appointment of Ralph A. Palmer (Jun. Mem. A. S. A. E.) as assistant secretary of the Society. Mr. Palmer is an agricultural engineering graduate of Ohio State University, class of 1926. He served as secretary-treasurer of the Ohio student branch of the Society during the latter part of his college course.

Opportunities for Engineers in Government Service

THE United States Civil Service Commission has recently issued a booklet, entitled "Opportunities for Engineers in the United States Civil Service," which should be of particular interest to all engineers interested in the possibility of employment in the government service. In addition to describing the opportunities for engineers in government service in a general way, the booklet presents the various branches of government service in which engineers are employed, and includes a table showing the salaries and distribution of government engineers. Copies of this booklet may be secured by addressing John T. Doyle, Secretary of the Commission, Washington, D. C.

U.S.D.A. Bulletin on Home Heating Burners

THE U. S. Department of Agriculture has issued as Department Circular No. 405-C a new bulletin, entitled "The Domestic Oil Burner." The division of agricultural engineering of the Department has conducted a great many tests and made a study of many installations, the results of which indicate the character of performance that may be expected of the several types of burners, the adaptability of existing heating plants, and the facts concerning oil fuel supplies and operation costs. Copies of the bulletin may be secured as long as the free supply lasts by writing the Department of Agriculture, Washington, D. C.

Hyatt Engineering Bulletin

THE Hyatt Engineering Bulletin No. 1561, containing forty pages of tables, formulas and drawings, of practical assistance to the designer and engineer and twenty-eight lay-outs showing approved and successful mountings of Hyatt roller bearings, has just been issued by the Hyatt Roller Bearing Company. The bulletin also contains chapters on bearing capacities, application of bearing loads, effects of bending and torsion on round solid shafts, and other relevant subjects. This bulletin is being distributed to engineers who can make real use of it in their everyday work. A request on the letterhead of your company or institution addressed to Hyatt Roller Bearing Company, Newark, New Jersey, or Chicago, Illinois, will bring you a copy.

Personals of A.S.A.E. Members

J. B. Clay, president, Iowa Gate Company, Inc., announces a change in the name of his company to Clay Equipment Corporation.

E. G. Johnson resigned recently as a member of the agricultural engineering staff of the University of Nebraska to become instructor in farm home utilities and farm buildings in the department of agricultural engineering at Iowa State College.

E. N. Bates, marketing specialist, U. S. Department of Agriculture, Portland, Oregon, is also secretary-treasurer of the Oregon Technical Council, which has been in existence for a number of years and is made up of delegates from local sections of national engineering societies, including A.S.C.E., A.S.M.E., A.I.E.E., A.I.M.M.E., A.I.A., N.E.L.A., A.A.E., and S.A.M.E. Mr. Bates also represents the A.S.M.E. local section on the Council.

New A.S.A.E. Members

Curtis C. Baldwin, vice-president, Gleaner Manufacturing Company, Independence, Missouri.

C. L. Best, chairman of the board, Caterpillar Tractor Co., San Leandro, California.

M. P. Brunig, instructor in agricultural engineering, University of Nebraska, Lincoln, Nebraska.

K. E. Gifford, production manager, The Central Tractor Co., Greenwich, Ohio.

H. H. Gordon, extension agricultural engineer, North Carolina State College, Raleigh, North Carolina.

A. W. Lavers, mechanical engineer, Minneapolis Steel & Machinery Co., Minneapolis, Minnesota.

P. W. Manson, assistant laboratory engineer, University Farm, St. Paul, Minnesota.

H. E. McCray, chief designer, Deere & Co., Moline, Ill.

C. N. Stone, Deere & Co., Moline, Ill.

R. T. Termohlen, Louden Machinery Co., Albany, N. Y.

W. J. P. Weeks, branch manager, J. B. Colt Company, New York, N. Y.

Transfer of Grade

C. L. Osterberger, agricultural engineer, Louisiana State University, Baton Rouge, Louisiana. (Junior to Associate Member.)

Applicants for Membership

The following is a list of applicants for membership in the American Society of Agricultural Engineers received since the publication of the February issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

Rudolph J. Altgelt, implement designer, Oliver Chilled Plow Works, South Bend, Indiana.

R. Dudley Barden, extension specialist, Ohio State University, Columbus, Ohio.

Sherman W. Cady, designing, improving and testing farm machinery, International Harvester Co., Chicago, Ill.

Arvy Carnes, assistant professor of agricultural engineering, Alabama Polytechnic Institute, Auburn, Alabama.

D. Howard Doane, agricultural engineer, Doane Agricultural Service, St. Louis, Missouri.

William Durbrow, managing and directing irrigation and reclamation works, Glenn-Colusa Irrigation District, Willows, California.

Harold E. Engstrom, civil engineer, Albert Lea Farms Co., Hollandale, Minnesota.

J. Raymond Golden, northwestern sales manager, Matthews Engineering Co., Sandusky, Ohio.

Alpheus M. Goodman, extension professor, N. Y. State College of Agriculture, Ithaca, N. Y.

John B. Gordon, agricultural field engineer, Portland Cement Association, Chicago, Illinois.

Greta Gray, professor of home economics, University of Nebraska, Lincoln, Nebraska.

G. D. Groce, service manager, The Cleveland Tractor Co., Cleveland, Ohio.

Joseph W. Gross, civil engineer, 1029 Forum Building, Sacramento, California.

Ivan Ivanoff, tractor student, Ford Motor Co., Detroit, Michigan.

A. E. W. Johnson, superintendent of experiments, International Harvester Co., Chicago, Ill.

Leon B. Lent, engineer, Common Brick Manufacturers' Association of America, Cleveland, Ohio.

T. A. H. Miller, associate agricultural engineer, U. S. Department of Agriculture, Branchville, Maryland.

John Novikoff, tractor mechanic, Ford Motor Co., Fordson, Michigan.

John W. Purcell, assistant engineer, Hydro-Electric Power Commission of Ontario, Toronto, Ontario.

Charles C. Ross, field engineer, King Ventilating Co., Owatonna, Minnesota.

William J. Schlick, drainage engineer, Iowa State College, Ames, Iowa.

Clement L. White, managing editor, The Pennsylvania Farmer, Lawrence Publishing Co., Philadelphia, Pennsylvania.

Augustus F. Whitfield, president, Clover Fork Coal Company, Kitts, Kentucky.

Horace J. Young, agricultural field engineer, Portland Cement Association, Lincoln, Nebraska.

Transfer of Grade

Walter T. Ackerman, state leader of electrical project, University of New Hampshire, Durham, N. H.

Wilbur M. Hurst, junior agricultural engineer, U.S.D.A. Bureau of Public Roads, Washington, D. C.

W. C. Krueger, University of Wisconsin, Madison, Wisconsin.

L. C. LeBron, extension agricultural engineer, Alabama Polytechnic Institute, Auburn, Alabama.

J. Dewey Long, junior agricultural engineer, University of California, Davis, California.

Walter A. Rowlands, assistant professor of agricultural engineering, University of Wisconsin, Madison, Wisconsin.

James A. Waller, Jr., assistant professor of agricultural engineering, Virginia Polytechnic Institute, Blacksburg, Virginia.

William J. Welker, instructor in agricultural engineering, Claresholm, Alberta, Canada.

Employment Bulletin

This service, conducted by the American Society of Agricultural Engineers, appears regularly in each issue of AGRICULTURAL ENGINEERING. Members of the Society in good standing will be listed in the published notices of the "Men Available" section. Nonmembers as well as members, are privileged to use the "Positions Open" section. Copy for notices should be in the Secretary's hands by the 20th of the month preceding date of issue. The form of notice should be such that the initial words indicate the classification. No charge will be made for this service.

Men Available

AGRICULTURAL ENGINEER available. Seventeen years experience in the designing and manufacture of farm tractors, motor trucks, harvesting machines, and earth-working tools. Sales experience in United States, Canada, England, France, and Italy. Write for interview. MA-132.

AGRICULTURAL ENGINEER, graduate of University of Illinois, nine years teaching experience as assistant professor in one of the largest universities of the central west. Eleven years manufacturing experience with one of the large tractor and farm implement builders. Experienced in production, design, and management. Desires position preferably as extension agricultural engineer or experimental or production manager work. MA-133.

AGRICULTURAL ENGINEER, 1926 graduate from Virginia Polytechnic Institute, desires position in some branch of agricultural engineering, preferably farm power and machinery. MA-136.

AGRICULTURAL ENGINEER, 1924 graduate of University of Wisconsin, desires permanent connection. Past experience includes tree surgery and tractor motor inspection. Prefers duty on private estate or investigational work. Edwin A. Bier, 515 N. Church St., Rockford, Ill.

Positions Open

WANTED mechanical designer experienced in layout work in connection with tractor design. Location Middle West. PO-121.

SALES MANAGER OR ASSISTANT SALES MANAGER WANTED. Agricultural engineer with sales experience preferred. Ample opportunity for advancement. Business now doing $500,000 volume on a varied line of farm equipment items in ten central western states. PO-122.

CIVIL SERVICE EXAMINATIONS FOR AGRICULTURAL ENGINEERS

The United States Civil Service Commission announces open competitive examinations for agricultural engineer ($3800.00), associate agricultural engineer ($3000.00), and assistant agricultural engineer ($2400.00). Applications for these positions must be on file with the U. S. Civil Service Commission, Washington, D. C., not later than March 22. The examinations are to fill vacancies in the Bureau of Public Roads of the U. S. Department of Agriculture for duty in Washington, D. C., or in the field, and in positions requiring similar qualifications. The entrance salaries are as indicated in parenthesis. Competitors will not be required to report for examination at any place, but will be rated on their education, training, experience, and fitness. The duties of these positions consist of research investigations relating to the uses, design, and operation of farm machinery and equipment; the designing of such machinery and equipment; and the furnishing of expert or critical advice on engineering and economic questions pertaining to agricultural machinery and equipment. The degree of responsibility depends upon the grade of position to which assigned. Full information and application blanks may be obtained from the United States Civil Service Commission, Washington, D. C., or the secretary of the board of U. S. civil service examiners at the post office or custom house in any city.